

Sport Fishery Abstracts

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes. The last number of each volume contains a list of publications screened for appropriate material.

Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

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Prepared in the Div. of Fishery Research
Paul S. Handwerk, Editor
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6441. Deevey, Edward S., Jr., and Minze Stuiver (Dept. of Biology and Geochronometric Lab., Yale Univ., New Haven, Connecticut). 1964. DISTRIBUTION OF NATURAL ISOTOPES OF CARBON IN LINSLEY POND AND OTHER NEW ENGLAND LAKES. *Limnology and Oceanography*, Vol. 9, No. 1, pp. 1-11.

One product of lake metabolism, the CO_2 that is produced anaerobically, is naturally labeled by its high C^{13} content, but in the presence of carbonates, even the modest amounts found in medium-hard Linsley Pond, such enrichment is not distinctive. Groundwater near the lake is highly charged (175 ml/liter) with CO_2 ; because its source includes ancient carbonate, it is naturally labeled as C^{14} -poor ($\Delta = 87.5$ 0/00). Combining these data with estimates of surface inflow, outflow, and other gains and losses of water and carbon, we can account for the C^{14} deficiency observed in hypolimnetic water ($\Delta = \text{ca. } -100$ 0/00) by a groundwater contribution of the order of 1 liter/($\text{m}^2 \times \text{day}$), perhaps less than 1% of the flow expected if the lake were not well insulated by a clay basin seal. Under ice, during the winter of 1961-62, C^{14} depletion of the deep water developed so rapidly as to suggest direct injection of groundwater and its accumulation by gravitational flow; however, groundwater carbon is ordinarily cycled metabolically, as shown by the fact that organic surface mud has an apparent age of ca. 1,000 years ($\delta\text{C}^{14} = -133$ 0/00). Inadequate knowledge of the hydrology of Linsley Pond interferes with rigorous description of the carbon balance, as does recent strong but irregular contamination of air by artificial (hydrogen-bomb) C^{14} . By 1960, submerged pondweeds and surface waters of several lakes were enriched in artificial C^{14} by less than 5%, while water-lily leaves, which use atmospheric rather than aquatic sources of carbon, were enriched by ca. 22%. Using the enrichment of Linsley Pond, 1.9% per year, as a tracer, we find the invasion of atmospheric CO_2 to be slow, ca. 1.2 moles/($\text{m}^2 \times \text{yr}$) (1.4 mg/($\text{cm}^2 \times \text{yr}$)). Contributions from groundwater and from air being small, and metabolism being an internal cycle that is nearly closed, the carbon balance of a small lake is seen as part of the hydrologic cycle and as dominated by bicarbonate in surface runoff. (Authors)

6442. Anthony, E. H., and F. R. Hayes (Inst. of Oceanog., Dalhousie Univ., Halifax, Nova Scotia). 1964. LAKE WATER AND SEDIMENT. VII. CHEMICAL AND OPTICAL PROPERTIES OF WATER IN RELATION TO THE BACTERIAL COUNTS IN THE SEDIMENTS OF TWENTY-FIVE NORTH AMERICAN LAKES. *Limnology and Oceanography*, Vol. 9, No. 1, pp. 35-41.

The variation in standing crop of bacteria in lake sediments is significantly explained by the equation:
 $\log \text{ bacteria} = 0.568 + 0.513 \log \text{ color} + 0.019 \text{ alkalinity}$
 where bacteria are in colonies per g dry sediment, from agar or membrane filter counts; alkalinity is methyl orange titration as ppm CaCO_3 ; and color is

in units of mg Pt/liter uncorrected for turbidity. The relations between alkalinity, Ca^{++} , Mg^{++} , conductivity, and residue on evaporation are so close that their measures serve as alternatives. Similarly, color is significantly related to measurements of optical density and turbidity and, in bog lakes, to oxygen consumption by the water. (Authors)

6443. Northcote, T. G. (Inst. of Fish., Univ. of British Columbia, Vancouver, B. C., Canada). 1964. USE OF A HIGH-FREQUENCY ECHO SOUNDER TO RECORD DISTRIBUTION AND MIGRATION OF *CHAOBORUS* LARVAE. *Limnology and Oceanography*, Vol. 9, No. 1, pp. 87-91.

A 200-kilocycle per second echo sounder is used to record presence of a marked scattering layer in a small eutrophic British Columbia lake. Evidence is presented that strongly suggests that *Chaoborus* larvae are largely responsible for this layer. Distribution and diel vertical migration of the layer in the lake is noted. (Auth.)

6444. McIntire, C. David, Robert L. Garrison, Harry K. Phinney, and Charles E. Warren (Pacific Cooperative Water Pollution and Fish. Res. Lab., Oregon State Univ., Corvallis). 1964. PRIMARY PRODUCTION IN LABORATORY STREAMS. *Limnology and Oceanography*, Vol. 9, No. 1, pp. 92-102.

Six laboratory streams are being used to study primary production and community respiration in simple communities under different environmental conditions. A photosynthesis-respiration chamber has been developed to perform experiments relating primary production to different environmental conditions and to verify primary production measurements made directly in the laboratory streams or in natural streams.

Gross primary production in the six streams under 6,000 lux of illumination ranged from 2.4 to 4.7 g of oxygen per m^2 per day. Community respiration ranged from 1.6 to 4.2 g of oxygen per m^2 per day. The P/R ratios usually varied between 1.0 and 2.0. The relationship between illumination intensity and primary production was approximately linear between zero and 4,000 lux, and maximum photosynthetic rates were obtained at about 21,000 lux. (Authors)

6445. Jitts, H. R. (Div. of Fish. and Oceanog., C.S.I.R.O., Cronulla, N. S. W., Australia). 1963. THE SIMULATED *IN SITU* MEASUREMENT OF OCEANIC PRIMARY PRODUCTION. *Australian Journal of Marine and Freshwater Research*, Vol. 14, No. 2, pp. 139-147.

Simultaneous measurements with two types of incubators were made on replicate samples both in the incubators and *in situ* in the ocean. Both incubators used sunlight and blue glass filters to simulate light conditions at depths in the ocean. The first gave measurements of column production 1.58 times those *in situ*. This was due to the fact that

at depths greater than 20 m the incubator gave much higher results with no significant relation to those measured in situ. In the second incubator the accuracy of reproduction of oceanic light conditions was improved by reducing reflected light and using a balance-by-depth twin photometer system for determining the depths of sampling. The measurements of column production in the second incubator were 1.03 times the in situ values. (Auth.)

6446. Kuenzler, E. J., R. R. L. Guillard, and N. Corwin (Woods Hole Oceanog. Inst., Woods Hole, Massachusetts). 1963. PHOSPHATE-FREE SEA WATER FOR REAGENT BLANKS IN CHEMICAL ANALYSES. Deep-Sea Research and Oceanographic Abstracts, Vol. 10, No. 6, pp. 749-755.

In comparing the methods of Wooster and Rakestraw (1951) and Murphy and Riley (1962) for phosphate analysis in sea water, we found the former to have a small, systematic positive error associated with the use of distilled water for the reagent blank (a 'hidden blank' according to Jones and Spencer (1963)). The error was eliminated by preparing blanks from sea water that had been rendered 'phosphate-free' by brief contact with phosphorus-deficient diatoms.

Neither analytical method hydrolyzed appreciable amounts of the soluble, non-phosphate phosphorus present in the sea water samples analyzed.

The diatom Phaeodactylum tricornutum Bohlin assimilated a significant fraction of the non-phosphate phosphorus present in the sea water samples studied, but not all of it.

Extracellular phosphatases were produced by P. tricornutum; the extent to which such extracellular enzymes may influence phosphate determinations is not known.

Hydrous zirconium oxide removed phosphate from sea water. However, it also removes other polyvalent ions and, therefore, it may be less satisfactory than algae for preparing sea water reagent blanks. (Authors)

6447. Boddeke, R. 1963. SIZE AND FEEDING OF DIFFERENT TYPES OF FISHES. Nature, Lond. 197: 714-715; The Journal of Animal Ecology, Vol. 32, No. 3, p. 585. 1963.

Body musculature and surface area is discussed in relation to type of swimming. Fuel storage increases more rapidly than drag on the surface as fish become larger, which gives the bigger fish a greater action radius. Two bottom-dwelling types are recognized, the slow-moving fish obtaining food by careful search and the fish-eating 'sprinters.' The predatory, pelagic fish are fast-moving 'stayers' showing a higher amount of red muscle tissue.

6448. Parnas, I., and M. Spiegelstein (Dept. of Zool., The Hebrew Univ., Jerusalem). 1963. EFFECT OF ILLUMINATION ON ICHTHYOTOXIC ACTIVITY OF PRYMNESIIUM PARVUM CARTER, IN AN AXENIC CULTURE AND IN FISH PONDS. Bamidgeh, Vol. 15, No. 2/3, pp. 50-59.

The effect of light on ichthyotoxin of Prymnesium parvum was examined in cultures under laboratory and pond conditions. It was found that the toxin is photolabile and is destroyed in visible light of up to 520 mμ and in ultraviolet light. In the pond, best growth occurred at a depth of 40 cm. No growth occurred on the surface. It appears that the active level in the pond at which Prymnesium grows and the toxin is released is between 40-60 cm. (Authors)

6449. Banse, K., C. P. Falls, and L. A. Hobson (Dept. of Oceanog., Univ. of Washington, Seattle). 1963. A GRAVIMETRIC METHOD FOR DETERMINING SUSPENDED MATTER IN SEA WATER USING MILLIPORE FILTERS. Deep-Sea Research and Oceanographic Abstracts, Vol. 10, No. 5, pp. 639-642.

A modification of earlier methods for the determination of the weight of suspended matter in 0.5 to 5 l. of sea water is presented. Filter pore size can be selected to meet the requirements of the experiment. The precision is ± 0.15 mg at the 95 percent level. The material can be subjected to subsequent analysis if the presence of the filter does not interfere. (Authors)

6450. Paperna, Ilan (Dept. of Parasitology, Hadassah Medical School, The Hebrew Univ., Jerusalem). 1963. DYNAMICS OF DACTYLOGYRUS VASTATOR NYBELIN (MONOGENEA) POPULATIONS ON THE GILLS OF CARP FRY IN FISH PONDS. Bamidgeh, Vol. 15, No. 2/3, pp. 31-50.

The population dynamics of Dactylogyrus vastator Nybelin (Dactylogyridae, Monogenea) in fish ponds are determined by the following factors: (a) The extent of the initial parasite contamination; (b) the growth rate of fingerlings in the ponds (this rate also determines the regenerative processes of the infected gill filaments); (c) the time interval between hatching of the fingerlings and contamination of the pond with D. vastator.

The size of the parasite population is largely dependent on the initial population level of the parasite, i.e., the number of parasite eggs already present or newly introduced into the pond.

In intensively growing fish, rapid propagation of the parasites is counteracted by growth of the fish and, consequently, no outbreaks or mortality occur, even in heavily infested ponds.

Following a period of infestation, there is a gradual drop in the number of gill parasites to the point where they disappear completely. Presence of the parasites on the gills induces hyperplasia of the marginal branchial epithelium and results in severe modification of gill function. In rapidly growing fish regenerative processes are also intensive and, consequently, there is little damage to the gills and no mortality despite a steady increase in the number of parasites on the gills. On the other hand, in fish whose growth is retarded, particularly when due to overcrowding, the regenerative processes are slow and, occasionally, cease altogether; histological changes then affect all the

gill filaments and the parasites are unable to propagate and frequently disappear from the gills. Destruction of the gills and disruption of the respiratory functions, however, are equally lethal to the afflicted fish. Surviving fish eventually become free of infestation, their gills undergo regeneration and are once more suitable sites for parasitization by *D. vastator*, the latter quickly infesting the regenerated gills. Thus, the pathological changes in the gills constitute an important factor in regulating the propagation of the parasite.

In ponds where encroachment of the parasite is delayed, mortality does not occur because the fingerlings attain a length of 35 mm before the parasites are sufficiently numerous to cause extensive branchial hyperplasia. In case of very heavy infestation, under laboratory conditions, the fishes may die even before onset of the characteristic histological changes in the gills. Death in such cases results from massive infestation of the gill filaments and rapid destruction of the gills. (Auth.)

6451. Falconer, Derek D. (Snobs Creek Freshwater Fisheries Research Station and Hatchery, Victoria, Australia). 1964. PRACTICAL TROUT TRANSPORT TECHNIQUES. Prog. Fish-Cult. 26(2): 51-58.

More than 2 million fish, ranging in size from fingerlings to 11-inch catchables, are distributed each year from a single hatchery. Transport of these fish involves the use of industrial compressed oxygen in liberation vehicles that travel 150 thousand miles annually. Equipment described in this paper includes the fleet of trucks, carrying containers, manifolds, aerators, flow meter, regulators or reducing valves, measuring drums, and dip nets, as well as modifications in aerial equipment. Loading densities for trucks and planes are discussed. (Auth.)

6452. Poston, Hugh A. (U. S. Bur. Sport Fish. and Wildl., Cortland, New York). 1964. EFFECT OF DIETARY VITAMIN K AND SULFAGUANIDINE ON BLOOD COAGULATION TIME, MICROHEMATOCRIT, AND GROWTH OF IMMATURE BROOK TROUT. Prog. Fish-Cult. 26(2): 59-64.

The effects of deleting vitamin K from, and adding sulfaguanidine (5 g./100 lb. of fish/day) to the synthetic, semipurified diet of brook trout (*Salvelinus fontinalis*) fingerlings on coagulation and microhematocrit values were studied for 16 weeks. The diets, followed by mean group coagulation time (seconds) and microhematocrit (%), respectively, were as follows: complete, 43.88, 44.03; complete minus vitamin K, 60.00, 38.19; complete plus sulfaguanidine, 59.12, 37.65; complete minus vitamin K plus sulfaguanidine, 67.62, 35.88. When vitamin K was deleted or sulfaguanidine added, in the presence or the absence of the other of these 2 ingredients, blood coagulation time was increased and microhematocrit values were decreased, both to a statistically significant extent. (Auth.)

6453. Krantz, George E., Jack M. Reddecliff, and

Carroll E. Heist (The Pennsylvania State Univ., University Park). 1964. IMMUNE RESPONSE OF TROUT TO *AEROMONAS SALMONICIDA*. PART II. EVALUATION OF FEEDING TECHNIQUES. Prog. Fish-Cult. 26(2): 65-69.

Evaluation of feeding techniques for the production of agglutinating antibody to *Aeromonas salmonicida* indicates that the 2 techniques tested are unsatisfactory for a hatchery immunization program. Attempts to immunize brook and brown trout by feeding chloroform-killed or viable *A. salmonicida* were not so effective as parenteral injection for producing detectable antibodies. Titers resulting from feeding and injecting viable bacteria and from naturally acquired infection are described. (Authors)

6454. Pyle, Earl A. (U. S. Bur. Sport Fish. and Wildl., Cortland, New York). 1964. THE EFFECT OF GRADING BY THE TOTAL WEIGHT GAINED BY BROWN TROUT. Prog. Fish-Cult. 26(2): 70-75.

Grading brown trout (*Salmo trutta*) populations into size groups did not increase the total weight gained by the fish or the efficiency of the conversion of food into flesh. These results confirm those previously reported for the grading of brook trout. Cannibalism was not a limiting factor in these studies. (Auth.)

6455. Gunning, Gerald E. (Tulane Univ., New Orleans, Louisiana), and C. Robert Shoop. 1964. STABILITY IN A HEADWATER STREAM POPULATION OF THE SHARPFIN CHUBSUCKER. Prog. Fish-Cult. 26(2): 76-79.

Short-term experiments with fin-clipped and tagged sharpfin chubsuckers (*Erimyzon tenuis*) indicated that most fish of this species limit themselves to a segment of stream approximately 50 ft. long for periods up to 2 months. A year-to-year experiment involving fin-clipped suckers indicated that a resident element of the population of Talisheek Creek can be identified from year to year. Intensive collecting in a limited segment of stream for a 3-year period led, indirectly, to the detection of a mobile element within the population. The latter was composed of very large suckers which evidently wandered into the study area from adjacent segments upstream or downstream. (Authors)

6456. Stauffer, Thomas M. (Michigan Dept. of Cons., Marquette). 1964. AN EXPERIMENTAL SEA LAMPREY BARRIER. Prog. Fish-Cult. 26(2): 80-83.

A barrier dam was designed to prevent upstream-migrating sea lampreys (*Petromyzon marinus*) from reaching their spawning grounds and to permit the upstream passage of other fish. The dam had an overhanging lip and was normally operated at a head of 2 to 3 ft. The depth of the pool immediately downstream from the face of the dam ranged from 2 to 4 ft. Sea lampreys could not surmount the dam at a head of 26 in. or more; escapement apparently occurred at heads of 20 in. and under. Rainbow trout (*Salmo gairdneri*) could surmount the lip at a head of at least 30 in. White suckers (*Catostomus*

commersoni), longnose suckers (C. catostomus), and American smelt (Osmerus mordax) were blocked at heads of 24 in. or more. Brook trout (Salvelinus fontinalis) and brown trout (Salmo trutta) could surmount the barrier at heads of at least 23 in. In certain small streams, a barrier dam may be a cheaper and more efficient method of sea lamprey control than electric weirs and larvicides. (Auth.)

6457. St. Amant, James A., William C. Johnson, and Marvin J. Whalls (California Dept. of Fish and Game, Chino). 1964. AQUALIN AS A FISH TOXICANT. Prog. Fish-Cult. 26(2): 84-88.

Aqualin (85% acrolein) can be used effectively to control goldfish. Goldfish subjected to 1.0 ppm or more of Aqualin in laboratory tanks died within 3 hours. Three ppm is recommended for field use. Detoxification in warm water occurs within 40 hours; detoxification in cold water may require more than 72 hours. Field tests indicate that Aqualin performs satisfactorily in reservoirs. (Authors)

6458. Conroy, D. A. (Instituto de Biologia Marina, Universidades Nacionales de Buenos Aires, Mar del Plata, Argentina). 1964. NOTES ON THE INCIDENCE OF PISCINE TUBERCULOSIS IN ARGENTINA. Prog. Fish-Cult. 26(2): 89-90.

The isolation of mycobacteria from freshwater fishes in Argentina is recorded, and gross pathological changes are described. A marine species, Trachurus picturatus, was shown to be infected with acid-fast bacilli. (Auth.)

6459. Marvin, Kenneth T. (U. S. Bur. Comm. Fish., Galveston, Texas). 1964. CONSTRUCTION OF FIBERGLASS WATER TANKS. Prog. Fish-Cult. 26(2): 91-92.

Instructions for building fiberglass water (aquarium) tanks. (Auth.)

6460. Moore, Clair W. (Wisconsin Cons. Dept., Wild Rose). 1964. A SIMPLIFIED METHOD FOR DIP-TREATING LARGE NUMBERS OF FISH. Prog. Fish-Cult. 26(2): 93-94.

The construction of a mobile stainless steel dip tank complete with hinged baskets and a chute for returning to the raceway fish that have been treated for external parasites and diseases. (Auth.)

6461. Hodgins, Harold O., and George J. Ridgway (U. S. Bur. Comm. Fish., Seattle, Washington). 1964. RECOVERY OF VIABLE SALMON SPERMATOOZOA AFTER FAST-FREEZING. Prog. Fish-Cult. 26(2): 95.

Spermatozoa from chinook (Oncorhynchus tshawytscha) and pink salmon (O. gorbuscha) were frozen in liquid nitrogen (-196° C) and recovered morphologically intact and still capable of motility. Dimethyl sulfoxide in a citrate-dextrose-sodium chloride solution was used as a protective additive. (Authors)

6462. Phillips, Arthur M., Jr. (U. S. Bur. Sport Fish. and Wildl., Cortland, New York). 1964. SALT IN TROUT DIETS. Prog. Fish-Cult. 26(2): 95.

A fortified salt such as livestock feeding salt may be used to provide a safety factor in areas of mineral-deficient soils.

6463. White, Billy L. (Texas Parks and Wildl. Dept., Brownsville), and Kenneth C. Jurgens. 1964. VEGETATION CONTROL WITH BLACK PLASTIC SHEETING. Prog. Fish-Cult. 26(2): 96.

Vegetation in fish rearing ponds has been effectively controlled by shading with black plastic sheeting. The advantages of this include savings in time, labor, and cost of materials.

6464. Klaas, Erwin E. (State Biol. Survey of Kansas, Univ. of Kansas, Lawrence). 1963. ECOLOGY OF THE TREMATODE, CLINOSTOMUM MARGINATUM, AND ITS HOSTS IN EASTERN KANSAS. Transactions of the Kansas Academy of Science, Vol. 66, No. 3, pp. 519-538.

Investigations in 1960 and 1961, to determine the extent of yellow grub infections and ecological factors associated with the occurrence and degree of infection, indicate that infections by yellow grubs in fish in farm ponds in Douglas County are frequent.

Of thirty-two ponds seined in August of 1960 and/or 1961, 28 contained fish, and 11 had infections of yellow grub. No apparent relationships existed between yellow grub infections, size and abundance of fish or physical features of the ponds.

The degree of infection in any one year ranged from 1.31 percent to 84.44 percent, but usually was less than 30 percent. The degree of infection in black bullheads usually exceeded that recorded in other species.

A natural means of control is preferred over the impractical elimination of herons or snails. It is postulated that reduction of submergent vegetation in a pond in order to limit snails to a smaller area near the shoreline may be a partial control. (Auth.)

6465. Ali, M. S. (Univ. Montreal, Montreal, Quebec, Canada). 1963. CORRELATION OF SOME RETINAL AND MORPHOLOGICAL MEASUREMENTS FROM THE ATLANTIC SALMON (SALMO SALAR). Growth 27(1): 57-76; Biological Abstracts, Vol. 44, No. 3, Abst. No. 11426. 1963.

Eyed embryos, alevins, fry, fingerlings, yearlings, 1.5 and 2-year-old parr were fixed under identical light conditions (25 ft-c). Lengths, weights, head, and eye diameters were measured. Eyes were sectioned and thicknesses of retinae, pigment, and cone layers were measured. Comparison of any 2 body measurements yielded very high coefficients of correlation ($r > 0.9762$). Scatter diagrams indicated rectilinear relationships. Coefficients of condition ($100W/L^3$) ranged between 0.4-2.2. All embryos and alevins yielded values between 1.0-2.2 due to the presence of yolk sacs. Correlation

between each pair of retinal measurements was of a high order ($r > +0.8695$). Relationships were rectilinear except when they were slightly disturbed by poor development of pigment in the embryos. Correlation of retinal-body measurements yielded significant coefficients ($r > +0.6055$); but these were not accurate due to curvilinear relationship fitting second or third degree parabolas. The diameters and retinal measurements of left and right eyes are highly correlated ($r > +0.8912$). Retinal thickness increases in proportion to growth in body measurements until maximum growth is attained, thereafter generally decreasing slightly in thickness which might appear to be due to the stretching of the retina as a result of the faster growth of body characteristics such as the size of the optic cup. (Auth.)

6466. Colley, Frederick C., and Andrew C. Olson, Jr. (San Diego State Coll., San Diego, California). 1963. POSTHODIPOSTOMUM MINIMUM (TREMATODA: DIPLOSTOMIDAE) IN FISHES OF LOWER OTAY RESERVOIR, SAN DIEGO COUNTY, CALIFORNIA. Jour. Parasitol. 49(1): 148; Biological Abstracts, Vol. 44, No. 3, Abst. No. 12764, 1963.

Fishes from Lower Otoy Reservoir, San Diego County, California, were examined for metacercariae of the trematode Posthodiplostomum minimum. Bluegills (Lepomis macrochirus) had the highest average number per fish. Decreasing averages were found in Florida bass (Micropterus salmoides floridans), crappie (Pomoxis annularis), green sunfish (Lepomis cyanellus), and brown bullheads (Ictalurus nebulosus). Greatest numbers were found in the liver. The kidney, heart and spleen had decreasing numbers in that order. Metacercariae removed from bluegills acclimated at 1.5° C, 3.5° C, and 36.0° C had lower viability when fed to day-old chicks than metacercariae from bluegills maintained at 15-20° C. (Authors)

6467. Petrushevskii, G. K. 1957. TURBELLARIAN WORMS AMONG EGGS OF THE SALMON IN A PISCICULTURE FARM. (RESNICHNYE CHERVI SREDI IKRY LOSOSYA NA RYBOVODNOM ZAVODE.) Izvest. Vses. Nauchn. Issled. Inst. Ozerного i Rechnogo Rybn. Khoz. 42. 327; Referat. Zhur., Biol., 1959, No. 49032; Biological Abstracts, Vol. 44, No. 3, Abst. No. 12844, 1963.

6468. Rosen, A. A. (Robt. A. Taft Sanit. Engng. Ctr., Cincinnati 26, Ohio), and Meyer Rubin. 1964. NATURAL CARBON-14 ACTIVITY OF ORGANIC SUBSTANCES IN STREAMS. Science, Vol. 143, No. 3611, pp. 1163-1164.

Carbon-14 measurements made on organic contaminants extracted from streams show percentages of industrial waste and domestic sewage. The method, used previously for studies of the atmosphere, can be used in studies of pollution sources. (Authors)

6469. Alvord, William, and John C. Peters (Montana Fish & Game Comm., Helena). 1963. CHANNEL CHANGES IN 13 MONTANA STREAMS.

Montana Fish & Game Comm., Fish. Div., 22 pp.

During 1962 thirteen Montana trout streams were surveyed to measure the amount of stream channel alterations and to determine the party responsible for the alterations. One-third of the total length of the streams surveyed (250 of 768 miles) had been altered from the natural condition. There were nearly three alterations per stream mile and the average length of a channel alteration was 664 feet. The most serious loss to fish production was nearly a 10 percent decrease in the natural length of stream channels. There were over 5 1/2 times as many catchable-sized trout and nearly 10 times as many whitefish censused in natural channels as in the altered channels. More than one-half of the alterations were attributable to road and railroad construction. Agricultural activities accounted for over one-third of the channel alterations, while the remainder were attributable to urban and industrial development projects.

6470. Martin, R. E., S. I. Auerbach, and D. J. Nelson (Oak Ridge National Lab., Oak Ridge, Tennessee). 1964. GROWTH AND MOVEMENT OF SMALLMOUTH BUFFALO, ICTIOBUS BUBALUS (RAFINESQUE), IN WATTS BAR RESERVOIR, TENNESSEE. Oak Ridge Natl. Lab., ORNL-3530, UC-48 - Biology and Medicine, 100 pp.

The smallmouth buffalo, Ictiobus bubalus (Rafinesque), population of Watts Bar Reservoir, Tennessee, was investigated in order to describe its age distribution, growth rates, dispersion, and importance as an accumulator of radionuclides. Measurements and scale samples were taken from commercially-caught fish and fish caught in the ORNL tagging operations. Scale impressions were analyzed for age and growth phenomena. Dispersion of smallmouth buffalo was investigated by conventional tagging methods and by autoradiographic analyses of scales. Stable and radiochemical composition of scales was examined by spectrographic analysis, flame spectrophotometry, and radiometric surveys.

Watts Bar smallmouth buffalo in the commercial catch ranged from four to fifteen years of age. The largest number of fish in the catch was from year-class six, the youngest year-class which was completely vulnerable to commercial fishing gear. Annulus formation occurred prior to June. The total survival rate was found to be 49 percent for year-class six, 35 percent for year-class seven, 26 percent for year-class eight, and 19 percent for year-class nine.

The rate of change in weight as length increased was 100 g/m for fish exceeding 31 cm in total length. Absolute growth was 422 mm at three years, 441 mm at six, 487 at seven, 522 mm at eight, and 609 mm at nine. The species characteristically exhibited the largest relative growth during the second year of life. Conditions for growth evidently had improved for the past six years as was indicated by an increase in total length attained at the end of succeeding years. Growth compensation was evident during the fourth and fifth years of life.

Calcium was the most abundant element in fish scales with at least twenty-three other elements present in varying quantities. Fish scales and bone were found to contain radionuclides of ruthenium, cesium, zirconium, zinc, and cobalt. Radiometric surveys of scales revealed the Watts Bar Reservoir smallmouth buffalo population was a relatively minor accumulator of radionuclides with only 0.08 percent showing the presence of artificially produced radionuclides. Approximately 6 percent of the Clinch River fish and 77 percent of the White Oak Creek fish had accumulations.

Limited data on dispersion were determined from conventional tags. Much more dispersion and life history data were determined from autoradiographic analyses of scales. These dispersion data were applied only to individuals because the number was too small for generalizations for the population as a whole.

All normal scales containing radionuclide accumulations were found to produce identical autoradiographic patterns of concentric circles which were associated with growth of the fish in contaminated areas. This phenomenon was combined with conventional capture-recapture methods of population estimates in a proposed technique of population studies. A laboratory experiment showed that scales could be tagged with cesium-134, but this radionuclide was found to accumulate in much larger concentrations in the soft tissues than in the bony tissues.

Data on population characteristics of the smallmouth buffalo are biologically significant in that they increase our basic knowledge of this commercially important species. The dispersion study is especially important in that an entirely new technique of study was developed and found to be superior to conventional tagging methods. (Authors)

6471. Toyomizu, Masamichi, Kenji Kawasaki, and Yukio Tomiyasu (Fish. Chem. Lab., Kyushu Univ., Fukuoka, Japan). 1963. EFFECT OF DIETARY OIL ON THE FATTY ACID COMPOSITION OF RAINBOW TROUT OIL. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 29, No. 10, pp. 957-961.

Recently much attention has been given to the enrichment of diet for fish by the addition of oil. Among the serious problems concerning it are the effects of dietary oil on the quality and quantity of the raised fish. The present paper is concerned with the effects of dietary oil on the fatty acid composition of rainbow trout (*Salmo gairdneri irideus*) which were fed on the various oil sources. Gas-liquid chromatography was utilized for this purpose.

In order to elucidate the change in fatty acid composition with growth of the fish, fish fed on a standard diet containing a typical marine oil were divided into three groups according to their body weight; namely, small, medium, and large. Data have shown that the fatty acid composition of these three groups was influenced by the dietary oil, especially in small-sized fish, while polyunsaturated fatty acids were reduced gradually with the

growth of the fish.

Four groups of fish (body weight ca. 90 g) were fed for 103 days on a standard diet and whale oil-, Alaska pollack oil-, and soybean oil-containing diets. As a result, fatty acids were apparently neither synthesized nor converted in those fish fed large amounts of the latter three oils, and the nature of oil in each group was influenced by the dietary oil. Moreover, it is interesting that, when fed on soybean oil, arachidonic acid, eicosapentaenoic acid, and docosahexaenoic acid were not detected in the group. (Authors)

6472. Larkin, P. A., and W. E. Ricker (Fish. Res. Bd. of Canada, Biol. Sta., Nanaimo, B. C., Canada). 1964. FURTHER INFORMATION ON SUSTAINED YIELDS FROM FLUCTUATING ENVIRONMENTS. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 1, pp. 1-7.

The conclusions of Ricker (1958) are confirmed in series of 200 generations in which environment effects are simulated. The best constant rate of exploitation is very close to the maximum equilibrium rate when there is no environmental variation. A higher catch is obtained when an optimum portion of the stock is reserved for escapement and the remainder is harvested up to the level of the maximum equilibrium rate. Still higher catches are associated with reserving an optimum portion of the catch for escapement and harvesting all of the remainder. In general, these kinds of benefits are greatest at higher levels of environmental variability. (Authors)

6473. Forrester, C. R. (Fish. Res. Bd. of Canada, Biol. Sta., Nanaimo, B. C., Canada). 1964. LABORATORY OBSERVATIONS ON EMBRYONIC DEVELOPMENT AND LARVAE OF THE PACIFIC COD (*GADUS MACROCEPHALUS* TILESIUS). Journal of the Fisheries Research Board of Canada, Vol. 21, No. 1, pp. 9-16.

The relationship between rate of development of eastern Pacific cod eggs and water temperature was found to be linear at temperatures of 5-11° C. Time to 50% hatching ranged from 8.5 days at 11° C to 17 days at 5° C. Most successful hatching occurred at the lowest temperature. Newly hatched larvae from 5° water had an average length of 4.45 mm. (Auth.)

6474. Sprague, J. B. (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, N. B., Canada). 1964. LETHAL CONCENTRATIONS OF COPPER AND ZINC FOR YOUNG ATLANTIC SALMON. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 1, pp. 17-26.

The toxicity of copper and zinc sulphates to immature Atlantic salmon (*Salmo salar* L.) was tested in soft water.

The relation between concentration of metal and survival-time could be fitted by a straight line when logarithms were used. A sharp break in this relation marked the incipient lethal level, where survival became indefinitely long. Incipient lethal

levels were 48 $\mu\text{g}/\text{l}$ of copper and 600 $\mu\text{g}/\text{l}$ of zinc.

In solutions containing both copper and zinc, fish died twice as fast as would occur if the 2 metals were simply additive in their lethal action. Resistance-times in zinc solutions were increased at pH 7.9-9.3, and results fitted the hypothesis that dissolved zinc was toxic, but not suspended zinc. Survival in a given concentration of zinc was 4 times as long at 5° as at 15° C, and the incipient lethal level was at least 1.5 times higher, with fish acclimated to each temperature. (Auth.)

6475. Saunders, Richard L., and John H. Gee (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, N. B., Canada). 1964. MOVEMENTS OF YOUNG ATLANTIC SALMON IN A SMALL STREAM. *Journal of the Fisheries Research Board of Canada*, Vol. 21, No. 1, pp. 27-36.

The locations of tagged parr and fin-clipped fry were observed from summer through early winter in a 1000-ft (328-m) study area of a small coastal stream. Tagged parr were usually found in or near places of original capture which are herein designated as homes. Parr whose homes were in pools, which appeared to be as suitable habitats as riffles, and those in adjacent riffles appeared to stay in their respective habitats. Some returned to their homes after having been moved as much as 700 ft (213 m) upriver or downriver. Fry were most numerous in shallow riffles and appeared to remain within small areas of the stream during summer but moved into parr habitats, the pools and deep riffles in autumn. (Authors)

6476. Kohler, A. C. (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, N. B., Canada). 1964. VARIATIONS IN THE GROWTH OF ATLANTIC COD (*GADUS MORHUA* L.). *Journal of the Fisheries Research Board of Canada*, Vol. 21, No. 1, pp. 57-100.

Growth rates of Atlantic cod vary both between populations in the same year and within a population over a series of years. The latter type of change is selected for detailed study, using an example found in the population resident in the western Gulf of St. Lawrence (ICNAF Division 4T). A real change in growth is verified by examining ageing methods, selectivity of sampling, tagging returns, and by measuring increments on the otoliths. Laboratory experiments showed that, when food supply is unlimited, food consumption increases with increasing temperature, and that growth increases with increasing food consumption. Direct correlation between temperature and growth changes is not established.

Cod growth changes in Division 4T are found to be the result of changes in abundance and availability of herring as food, plus changes in competition for food resulting from density changes in fish-eating members of the cod population. (Auth.)

6477. Baslow, Morris H. (Dept. of Mar. Biochem. and Ecol., New York Aquarium, New York Zoological Society, New York). 1964. NEUROSINE, A

NEW OLIGOPEPTIDE ISOLATED FROM THE BRAIN OF FISH AND OTHER COLD-BLOODED VERTEBRATES. 1. IDENTIFICATION AND PARTIAL CHARACTERIZATION. *Journal of the Fisheries Research Board of Canada*, Vol. 21, No. 1, pp. 107-113.

Analysis of fish brain for the dipeptide homocarnosine has led to the discovery of a new oligopeptide which is named neurosine. This substance contains γ -aminobutyric acid (GABA) and histidine residues. Most of the histidine present in a water soluble fraction from fish brain appears to be in the form of a tetrapeptide consisting of glycine, glutamic acid, GABA and histidine. Neurosine is ninhydrin negative, heat stable, and has a high R_f value when chromatographed in a butanol-acetic acid-water solvent system. The evidence at present suggests that this compound may be a cyclopeptide or contains a pyrrolidone or diketopiperazine ring structure.

Neurosine is present in high concentration in the brain of the killifish, *Fundulus heteroclitus*, approximately 0.1-1.0 μg of peptide per milligram of tissue. It also has been found in other bony fish, amphibians and reptiles but is absent in cyclostomes, elasmobranchs, birds and mammals. Neurosine is not present in any tissue but brain. (Auth.)

6478. Swift, D. R. (The Freshwater Biol. Assoc., The Ferry House, Far Sawrey, Ambleside, Westmorland, England). 1964. ACTIVITY CYCLES IN THE BROWN TROUT (*SALMO TRUTTA* L.). 2. FISH ARTIFICIALLY FED. *Journal of the Fisheries Research Board of Canada*, Vol. 21, No. 1, pp. 133-138.

The diurnal and annual locomotory activity cycles of four brown trout confined in separate cages on the bed of Windermere and fed artificially from the lake surface are described. The annual activity curves were very similar, the fish being less active during the winter than in the summer with maximum activity occurring in June and again in August. The diurnal activity patterns were also very similar with a sharp rise in activity at dawn each day after an inactive night, the increased activity being maintained throughout the light period and falling rapidly at dusk.

Two of the fish were fed daily at irregular times and two were fed automatically every 2 hours. The similarity of the activity patterns of these four fish and also the similarity to the patterns of unfed fish described in a previous paper suggests that light and not food is the prime stimulus to locomotory activity in brown trout. (Auth.)

6479. Jitts, H. R., C. D. McAllister, K. Stephens, and J. D. H. Strickland (Fish. Res. Bd. of Canada, Biol. Sta., Nanaimo, B. C., Canada). 1964. THE CELL DIVISION RATES OF SOME MARINE PHYTOPLANKTERS AS A FUNCTION OF LIGHT AND TEMPERATURE. *Journal of the Fisheries Research Board of Canada*, Vol. 21, No. 1, pp. 139-157.

An apparatus is described for exposing phytoplankton cultures to 64 different combinations of

light and temperature. The light was of a known spectral energy resembling sunlight after passage through a few meters of clear coastal sea water and was measured in the energy units of cal/cm²/min (langlies/min or ly/min). The temperature range used varied in each experiment, the range of illumination was from about 0.005 to 0.4 ly/min, the latter being equivalent to bright summer sunlight at a depth of only a few meters in the sea.

The growth of five bacteria-free cultures, *Dunaliella tertiolecta*, *Amphidinium carteri*, *Monochrysis lutheri*, *Skeletonema costatum* and *Thalassiosira nordenskiöldii* was followed for a period of 3-5 days using a cycle of 16 hr. illumination and 8 hr. of darkness every 24 hr. Growth was measured by counting cell numbers and the rate constants for cell division were evaluated at standard times.

The resulting growth-response curves are reported and discussed in relation to their ecological significance. Except for *T. nordenskiöldii*, cell division was relatively insensitive to temperature over a range exceeding 10° C. Cell division showed a "stress" response, the growth rate being more susceptible to extremes of illumination when the cells were near to the extremes of temperature for a given species and to extremes of both temperature and light if the chemical nature of the medium was unsatisfactory. At optimum temperatures there was no inhibition of cell division at intensities of 0.4 ly/min of photosynthetically active light. (Authors)

6480. Bary, B. McK. (Inst. of Oceanog., Univ. of British Columbia, Vancouver 8, B. C., Canada). 1964. TEMPERATURE, SALINITY AND PLANKTON IN THE EASTERN NORTH ATLANTIC AND COASTAL WATERS OF BRITAIN, 1957. IV. THE SPECIES' RELATIONSHIP TO THE WATER BODY, ITS ROLE IN DISTRIBUTION AND IN SELECTING AND USING INDICATOR SPECIES. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 1, pp. 183-202.

Temperature and salinity have been used to characterize the surface water bodies of the oceanic eastern North Atlantic and coastal waters of Britain. Species of plankton have been entered on temperature-salinity diagrams and it has been demonstrated that each is related in a characteristic manner to one or more of the water bodies, or their extended influences in mixtures. This relationship is maintained by each species regardless of seasonal temperature fluctuations of the water bodies, and within the available salinity variations. Species may be present concurrently in oceanic water of one temperature and oceanic-coastal water of a different, lower temperature. Increases and decreases in numbers of a species occur within the limits of these water bodies. These factors are regarded as demonstrating, for the area investigated, that species' occurrences and distributions may not be dependent on temperature and salinity.

Discontinuities occur in the distribution of species, chiefly at boundary zones between different

water bodies. These arise because some species may cross the boundary zone into another water, while other species of similar origin do not (or cannot).

An hypothesis is proposed to explain these features. Unspecified properties are postulated for those water bodies which are contributing to mixed waters in the area studied. The relationships of the species are regarded as being regulated by their tolerances towards the properties; and occurrences and distributions of the species are discussed relative to the presence of the properties. It is considered that the species' reactions to the properties provide a reasonable basis on which to explain the relationships to the waters in the area, their apparent independence of seasonal temperature changes, and the species' distribution. (Auth.)

6481. Nomura, Minoru (Tokyo Univ. Fish., Minato-ku, Tokyo, Japan). 1963. STUDIES ON REPRODUCTION OF RAINBOW TROUT, *SALMO GAIARDNERI*, WITH SPECIAL REFERENCE TO EGG TAKING. V. DEVELOPMENT OF GONADS AND SIZE OF FISH SPAWNED FIRSTLY. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 29, No. 11, pp. 976-984.

The seasonal changes in the weight of gonads, liver and viscera, as well as the chemical composition of these organs and muscle of rainbow trout reared at the Oizumi Trout Hatchery were studied. The relationship between the growth of the fish and the development of gonads was also investigated, and the status of initial spawning of 2-year fish was discussed. The weight of organs was shown by the relative values against body weight. Net body weight (body weight minus weight of gonads) was used for referring to the weight of liver and viscera, and total body weight in reference to the gonad weight. The viscera used for chemical analysis excluded gonads and liver. For the calculation of relative weight, the gonads were removed from the viscera.

The results obtained were as follows:

(1) The relative weight of the ovary increases rapidly during the months preceding spawning, and reaches the maximum weight just before ovulation of all ripe eggs. The testis reaches maximum weight in prespawning season (October), followed by a gradual decrease in weight after the discharge of its products.

(2) The seasonal changes in the relative weight of viscera, which are affected mainly by the amount of fat on intestinal organs, shows a similar tendency in both sexes in terms of fluctuation and magnitude. But the relative weight of liver in both sexes changes in a positive relation to the growth of the ovary and testis, respectively. Protein, fat, and ash contents of liver increase with the increase in total weight.

(3) The growth rate observed in length and weight of female fish decreases continuously after the onset of sexual maturity. During the months of rapid increase of ovary especially, females

show little growth.

(4) Among yearlings of the same age, expressed in months, the larger fish have a large relative weight of ovary. The average value of the relative weight of total eggs stripped from 2-year-olds which spawn for the first time was nearly 11%. If this value is desired for two-year-old spawners, it is necessary that fish grow about 30 cm in body length or nearly 500 g in weight within 2 years.

(5) In order to increase the fecundity and use of younger brood fish (2-year-olds) for egg taking, it is necessary that the fish be well fed during the months that the gonads increase in size and weight. (Auth.)

6482. Yanase, Masaaki (Tokai Reg. Fish. Res. Lab., Chuo-ku, Tokyo, Japan). 1963. PANTOTHENIC ACID AND VITAMIN B₁₂ CONTENTS ASSESSED FOR THE RAINBOW TROUT DURING MATURATION. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 29, No. 11, pp. 1024-1030.

A trout hatchery in Tokyo started feeding rainbow trout (*Salmo irideus*) with a formulated diet in June 1961. To study possible relationships between fish maturity and their vitamin contents, a number of the fish reared in the hatchery were sampled at different stages of maturity--one, four, or seven months before spawning. Microbiological analysis was performed for levels of pantothenic acid and vitamin B₁₂ in various organs of the sample fish. The analytical results indicate no definite relation between the pantothenic acid contents and maturity of the rainbow trout. However, samples in the most advanced stage of maturation show remarkable increases of the vitamin B₁₂ level in various organs, except the ovary. This fact suggests that vitamin B₁₂ plays a role in maturity of the fish. (Auth.)

6483. Mayhew, Jim (Iowa State Cons. Comm., Des Moines). 1963. SPRING, WATER PHENOMENON, AND EARLY FISHING. Iowa Conserv. 22(4): 25, 30; Biological Abstracts, Vol. 44, No. 4, Abst. No. 13074. 1963.

Crappies (*Pomoxis* species) and bluegills (*Lepomis macrochirus*) spend the winter near the lake bottom but distribute themselves to all depths at the spring overturn. Bullheads (*Ictalurus melas*) winter near the ice but were found mostly in deeper water as the water warmed in the spring. (K. D. C.)

6484. Trautman, Milton B. 1963. SOLITARY CARNIVORE. NORTH AMERICAN BROWN BEAR (*URSUS MIDDENDORFFI*) BEHAVIOR ALTERS DURING SALMON RUNS. Nat. Hist. 72(1): 10-19; Biological Abstracts, Vol. 44, No. 4, Abst. No. 13094. 1963.

6485. Doi, Takeyuki (Tokai Reg. Fish. Res. Lab., Tokyo, Japan). 1962. ON THE PROBLEMS OF POPULATION DYNAMICS RELEVANT TO IMMATURE SALMON CAUGHT OFFSHORE IN THE NORTH PACIFIC. Bull. Tokai Reg. Fish. Res.

Lab. 35. 1-8; Biological Abstracts, Vol. 44, No. 4, Abst. No. 13568. 1963.

This report describes procedures for estimating population parameters relevant to immature salmon, and evaluates the effects of catching them. Catching the immatures is not always unreasonable from the standpoint of utilization of population recruited into fishing grounds. As illustrated by chum salmon, the effect of catching immatures on reproduction depends upon the relative positions of optimum and actual levels of spawning adults, at least in a sustainable yield, although the loss of spawning adults by catching the immatures seems to be comparatively small in the actual situation. In order to investigate this interesting problem, it is necessary to study the reproduction mechanism and to estimate population parameters more accurately, especially natural and fishing mortalities. (Auth.)

6486. Frank, Stanislav (Dept. Zool., Charles Univ., Prague, Czechoslovakia). 1962. TO THE BIOLOGY OF THE LARGEMOUTH BLACK BASS (*MICROPTERUS SALMOIDES*). Vestnik Českoslov. Společnosti Zool. 26(3): 240-243; Biological Abstracts, Vol. 44, No. 4, Abst. No. 13570. 1963.

The growth of largemouth black bass reaches only the lower limit of what is reported from its native North America. This can be explained only by its poor orientation while feeding in waters of low transparency. The growth of this carnivorous species is closely related to food conditions and quickly changes with improvement of deterioration. (Auth.)

6487. Hickling, C. F. 1962. FISH CULTURE. Faber and Faber: London. W. C. 1, 295 pp., Biological Abstracts, Vol. 44, No. 4, Abst. No. 13572. 1963.

This book is concerned with the production of fish for human food, one of the world's most efficient ways of producing protein. Following introductory chapters, the headings include different kinds of fish culture; water; soil; the dry period; pond construction and management; fertilizers; supplementary feeding and foods; fish culture in brackish water, running water, and rice fields; stocking rates and times for best yields; fish genetics and hybridization; fish diseases, and fishponds and public health. The author is former director of the Tropical Fish Culture Research Institute in Malacca. Many examples are cited from Europe, Russia, Israel, and the Orient. The book is abundantly illustrated and contains an excellent index and a bibliography with 184 references. (C. C. S., Jr.)

6488. Ivlev, V. S. 1962. METHODS OF DETERMINING PREFERRED TEMPERATURE. (METODY OPREDELENIYA IZBIRAEMOI TEMPERATURY.) Akad. Nauk SSSR: Moscow. 344-353; Referat. Zhur., Biol., 1963, No. 7120; Biological Abstracts, Vol. 44, No. 4, Abst. No. 13574. 1963.

Plans for thermogradient devices are described. Initial data on fish distribution are obtained from

their taking up a position at a particular temperature, recorded through an equal time interval. The basic index of preferred temperature is the modal temperature at which the largest number of findings were recorded. The character of fish distribution in the presence of a temperature gradient was expressed by a distribution curve which differs from the normal distribution by its "excess" and its asymmetry. Indices of excess and asymmetry have important biological significance: the former represents the eury- or stenothermal nature of the subject, and the latter its preference for high or low temperatures. In view of the small number of variables, the usual statistical methods of calculating these indices were insufficient for obtaining reliable data. A new way of calculating the indices of excess and asymmetry is suggested, based on the method of graphic integration of a distribution curve. The index of eurythermicity (excess), β , is:

$$\beta = \frac{1}{M_0} \int_{t_{\min}}^{t_{\max}} n \cdot dt,$$

where n is the number of fish found at a given temperature, M_0 is the mode, %; $t_{\max}$ and $t_{\min}$ are the maximum and minimum temperatures limiting the fish distribution interval. The index of thermosymmetry, X , is:

$$X = \frac{\int_{t_M}^{t_{\max}} n \cdot dt - \int_{t_{\min}}^{t_M} n \cdot dt}{t_{\max} - t_{\min}},$$

where $t_{\max}$, $t_{\min}$, and t_M are the maximum, minimum, and modal temperatures. Integration of distribution curves was done by planimetry. Bibliography with 12 references.

6489. Karlovac, Jozica (Inst. Oceanogr. Peche, Split., Yugoslavia). 1962. ANALYSIS OF THE CONTENT OF THE DIGESTIVE TRACT OF THE PLANKTONIC STAGES OF MACKEREL IN THE ADRIATIC SEA. (SPITIVANJE SADRZAJA PROBAVNOG TRAKTA KOD PLANKTONSKOG STADIJA SKUSE (SCOMBER SCOMBRUS L.) U JADRANU.) Inst. Oceanogr. i Ribarstvo-Split FNR, Jugoslavija 4(4A): 15; Biological Abstracts, Vol. 44, No. 4, Abst. No. 13576. 1963.

Twenty-three hauls out of 445 yielded 142 postlarval mackerel. The most common organisms in the stomachs were Copelata, larval and postlarval fish, copepods, and cladocerans. The relationship of feeding to time of day is discussed. (A. C.)

6490. Lindroth, Arne. 1963. THE BODY/SCALE RELATIONSHIP IN ATLANTIC SALMON (SALMO SALAR L.): A PRELIMINARY REPORT. Jour. Cons. 28(1): 137-152; Biological Abstracts, Vol. 44, No. 4, Abst. No. 13577. 1963.

Data are presented on the body/scale relationship of parr, post-smolt and adults of Atlantic salmon. Back-calculation of adult size can be

made by direct proportion; back-calculation of parr size from parr scales can be made in the same way after the introduction of a correction term; back-calculation of parr size from adult scales is complicated by the transition from the adult of parr scale curve. A provisional method for overcoming the difficulty is indicated. The general trend of body/scale relationships in fishes and the sources of variance in relative scale size data are discussed. The connection between scale form and body form is stressed and this is of special interest in the salmon where the transition from parr form to adult body form at smoltification is accompanied by a corresponding change in scale form. Variations in relative scale dimensions within and between fish, within and between times and season are surveyed and their effects on body/scale curves discussed. The present data indicate changes in scale form and relative scale dimensions with the growth rate (condition) of the fish which imply fluctuations of relative scale growth. If further work corroborates this finding, the theoretical foundations of back-calculation by means of scales will have to be reconsidered. The practical significance may, however, be of minor importance. (Auth.)

6491. Miller, David, John B. Colton, Jr., and Robert R. Marak (Fish and Wildlife Serv., Woods Hole, Massachusetts). 1963. A STUDY OF THE VERTICAL DISTRIBUTION OF LARVAL HADDOCK. Jour. Cons. 28(1): 37-49; Biological Abstracts, Vol. 44, No. 4, Abst. No. 13581. 1963.

The study was made at three locations on Georges Bank in May 1958, using a high-speed, multidepth sampling technique. Each of 3 stations was occupied for 2 consecutive days, one 30 minute tow being taken every 2 hours. Stations were marked by means of a free-drifting buoy in order that sampling would be restricted to a specific water mass. The sampling technique employed was successful in eliminating differences in day and night catches due to larval escapement. Although haddock larvae occurred throughout at least the upper 50 m of the water column, maximum concentrations were centered between 20 and 30 m. Periodic changes in larval depth distribution were demonstrated. The relationship of these changes to periodic fluctuations in the depth of the thermocline is evident. Over 80% of the larvae occurred within the confines of the thermocline. Data collected at Station I suggest that very small larvae, 4-8 mm in length, had a distinctly different distribution, occurring below the thermocline. (Authors)

6492. Saila, Saul B. (Narragansett Mar. Lab., Univ. of Rhode Island, Kingston), and Raymond A. Shappy. 1963. RANDOM MOVEMENT AND ORIENTATION IN SALMON MIGRATION. Jour. Cons. 28(1): 153-166; Biological Abstracts, Vol. 44, No. 4, Abst. No. 13583. 1963.

A numerical probability model (Monte Carlo method) of the migration of salmonid fishes was developed. Empirical values for the model parameters available from published literature were

utilized to demonstrate the plausibility of the model as an explanation for migration in the sea, and to provide a quantitative indication of the degree of orientation required to provide a high return probability. Specifically, a random number generator in a high-speed digital computer was used to allow a hypothetical migratory fish to choose an azimuthal direction of travel. The angle between the randomly chosen direction and the east-west axis was entered into the parametric form of a cardioid to produce a "step vector" as follows: $R = P + Q \cos \theta$. This was repeated until (a) the allotted search time for the animal expired, or (b) the accumulated east-west displacement exceeded the specified straight-line distance between the starting point and a north-south barrier (the coast). A small strip of coast was designated as "home." If an individual reached the coast, the cardioid model was dropped and the random walk continued along the coast until the remaining search time was completely used or the animal arrived "home." A return probability of 37% (significantly higher than observed returns based on tag recoveries) was achieved with a model utilizing random movement combined with only a small amount of orientation. It was concluded that neither navigation nor precise orientation was necessary to explain the large scale migration of salmon to the vicinity of their natal streams from distant feeding areas. It is submitted that construction and manipulation of a mathematical model is helpful in achieving a better understanding of any phenomenon. The model discussed above is admittedly an oversimplification of a complex biological phenomenon. However, because of the paucity of empirical data regarding the migrant's endurance and the unknown nature of the frequency distribution of lengths of step vectors, a more complex set of assumptions does not appear to be justified. Nevertheless, the results indicated by this model do not suggest the necessity of navigational ability or even precise directional orientation on the part of migrating salmonid fishes. We await the firm foundation of diverse biological data to support or modify our hypothesis. (Authors)

6493. Wrobel, Stanislaw. 1963. INFLUENCE OF CHANGES IN ATMOSPHERIC CONDITIONS ON THE DIURNAL FLUCTUATIONS OF CERTAIN CHARACTERISTICS OF POND WATER. (WECHSELWIRKUNG ATMOSPHERISCHER ZUSTANDE AUF DIE TAGESSCHWANKUNGEN EINIGER FAKTORN IM TEICHWASSER.) Acta Hydrobiol. 5(1): 73-77; Biological Abstracts, Vol. 44, No. 4, Abst. No. 13586. 1963.

Measurements of temperature, pH, alkalinity, and oxygen contents of water were carried out in various weathers. A decrease of oxygen content due to sky cloudiness was observed and its importance in fish farming was discussed. (K. A.)

6494. Zieba, Jerzy. 1963. INFLUENCE OF THE FEEDING OF CARP ON INSECT LARVAE LIVING AT THE BOTTOM OF A POND. (WPLYW ZEROWANIA KARPJA NA ZASIEDLENIE DNA STAWU

PRZEZ LARWY OWADOW.) Acta Hydrobiol. 5(1): 31-42; Biological Abstracts, Vol. 44, No. 4, Abst. No. 13588. 1963.

Variation in density of Oligochaeta and Tendipedidae, and also of less numerous animal groups, was investigated in 4 inclosed areas at different pond depths in which carp fed. The results were compared with those in the control areas (without carp) and the feeding of carp was found to have a less direct influence on seasonal numerical variance than some other environmental features. (K. Z.)

6495. Faktorovich, K. A. 1961. THE EFFECT OF VITAMINS ON THE LIVER CONDITION OF RAINBOW TROUT (*SALMO TRUTTA IRIDEUS*). (VLIYANIE VITAMINOV NA SOSTOYANIE PECHE-NI RADUZHNOI FORELI.) Izvest. Gos. Nauchn. Inst. Ozerного i Rechnogo Rybn. Khoz. 51: 47-51, 268; Referat. Zhur., Biol., 1963, No. 714; Biological Abstracts, Vol. 44, No. 4, Abst. No. 13925. 1963.

Three groups of *Salmo trutta irideus* fingerlings, were fed the following rations: meat-bone meal (75%) plus barley meal (25%); the same plus synthetic vitamins A, B₁, B₂, B₁₂, D, C, and niacin; and meat-bone meal (37.5%) plus barley meal (12.5%) plus 50% peptone-corn agar, containing a killed culture of microorganisms, rich with vitamins A, B₁, B₂, B₁₂, and D. This latter ration was the most favorable. The liver tissue of the fingerlings growing on this ration was solid with no fatty cavities; the cytoplasm of the cells was granular; and the nuclei were round. The liver tissue of the fingerlings maintained on the 2nd ration contained a great number of fat cavities; the cytoplasm was located in narrow layers between the fat cavities; and the nuclei were round or somewhat deformed by fatty inclusions. The amount of fat in the liver of these fingerlings was considerably more than in those fed the 1st ration. Those trout fed the diet without added vitamins assimilated an insignificant amount of food.

6496. Buhler, Donald R. (Upjohn Co., Kalamazoo, Michigan). 1963. STUDIES ON FISH HEMOGLOBINS. CHINOOK SALMON AND RAINBOW TROUT. Jour. Biol. Chem. 238(5): 1665-1674; Biological Abstracts, Vol. 44, No. 4, Abst. No. 14259. 1963.

The hemoglobins from chinook salmon and two of the three hemoglobins from rainbow trout have been isolated and purified via chromatography on diethylaminoethyl cellulose. The electrophoretically slower chinook salmon and rainbow trout hemoglobins, designated Hb-CS₁ and Hb-RT₁, have been characterized and shown to have remarkably similar properties. Hb-CS₁ and Hb-RT₁ have isoelectric points of pH 7.52 and 7.29, respectively, show an increased resistance towards alkaline denaturation, have very similar amino acid compositions with 2 or 3 half-cystine residues per molecule of assumed 68,000 molecular weight, 1 detectable NH₂-terminal residue with the sequence (NH₂) Val-Glu, and 1 COOH-terminal residue with the sequence Tyr-Phe

(COOH). Similarly, the electrophoretically faster chinook salmon and rainbow trout hemoglobins, designated Hb-CS₂ and Hb-RT₃, also have been found to be very much alike. These hemoglobins have isoelectric points of pH 6.85 and 6.40, respectively, are easily denatured by alkali, have comparable amino acid compositions with half-cystine residues per molecule of assumed 68,000 molecular weight, and exhibit 1 COOH-terminal residue with the sequence Tyr-His (COOH). Although the NH₂-terminal peptide sequence for both Hb-CS₂ and Hb-RT₃ was found to be (NH₂) Val-Asp, Hb-CS₂ was observed to contain 2 NH₂-terminal valine residues per 68,000 molecular weight; whereas, Hb-RT₃ only displayed 1 such residue per molecule. (Auth.)

6497. Holovatskyi, I. D., B. S. Avdos'yev, and Z. P. Nazardevych (L'vov Zoovet. Inst., L'vov, Ukrain. SSR). 1963. THE CHEMICAL COMPOSITION OF THE BLOOD OF SOME FISH (CARP, SAZAN). (PRO KHIMICHNYI SKLAD KROVI DEY-AKYKH RYB (KOROP, SAZAN).) Ukrain. Biokhim. Zhur. 35(2): 234-238; Biological Abstracts, Vol. 44, No. 4, Abst. No. 14267. 1963.

The authors investigated the blood of two- and three-year-old fish (carp and sazan) for content of various monosaccharides, phosphates, adenylates, lactic acid and ketone bodies. It was found that fish blood contains a great quantity of monosaccharides, ATP, and phosphates. Their concentrations are considerably higher than in warm-blooded animals. There are no substantial differences in the quantities of ketone bodies. The principal carbohydrate component is glucose, localized in the blood plasma. Second place is occupied by pentoses (adenylic compounds and ribosophosphates), which are concentrated in the erythrocytes and, partly, in the plasma. Fructose takes third place. It is distributed in the plasma and in the erythrocytes. Readily hydrolyzed phosphorus, ATP, and the basic quantity of inorganic phosphates are contained in the erythrocytes. Lactic acid concentration predominates in the plasma, while ketone bodies are almost equally distributed between the plasma and the erythrocytes. Certain differences were noted in the two- and three-year-old fish in respect to the concentration of some of the investigated compounds; in particular, there is more ATP and less inorganic phosphates in two-year-old fish. (Authors)

6498. Mazunin, N. A., and Zh. Karantaeva. 1961. MORPHOLOGY OF GROWTH CHANGES IN CYPRINUS CARPIO OVARIES. (K MORFOLOGII VOZ-RASTNYKH IZMENENII YAICHNIKOV SAZANA.) Uch. Zap. Kazakhsk. Univ. Ser. Biol. 41: 113-123; Referat. Zhur., Biol., 1963, No. 6124; Biological Abstracts, Vol. 44, No. 4, Abst. No. 14365. 1963.

The histology of ovaries of various aged Cyprinus carpio caught in Lake Balkhash in June-July 1957 and March 1958 are described. For the oogonial phase and protoplasmic growth (estral phase of the sexual cycle), an asynchronous development of the sexual elements was characteristic.

For trophoplasmic and trophic growth (seasonal phase), it was synchronous, related to an increase in connective tissue--vascular trophism. In young and adult fish, the estral phase was clearly developed in the beginning stages of ovary maturation, and then slowly died (but did not end). The seasonal phase was characteristic of the final stage.

6499. Murachi, Shiro (Dept. Fish., Hiroshima Univ., Fukuyama, Japan). 1962. SYMPTOMS APPEARING IN THE EYE FUNDUS OF THE GOLD-FISH AFFECTED BY DRUGS. Jour. Fac. Fish. and Animal Husbandry Hiroshima Univ. 4(1/2): 111-165; Biological Abstracts, Vol. 44, No. 4, Abst. No. 14587. 1964.

The fundus of the goldfish was sensitive to 34 kinds of drugs. Harmful effects of these drugs on the vitality of the fish could be successfully avoided by removing the fish into a normal rearing medium upon finding symptoms of the incipient stage. The fundus of the goldfish was highly sensitive to the accumulation of metabolic wastes in the environmental medium, but not so sensitive to the effect of laboring breath or to the hypertonicity of the environmental medium. The goldfish killed instantly could be distinguished from those asphyxiated by examining their fundi. (Authors)

6500. Reznichenko, P. N. 1958. THE ONTOGENESIS OF THE EMBRYONIC MOTOR ACTIVITY IN THE PIKE. (ONTOGENEZ EMBRIONAL'NOI MOTORIKI SHCHUKI.) Tr. Soveshch. Ikhtiol. Komis. Akad. Nauk SSSR. 8. 393-409; Referat. Zhur., Biol., 1960, No. 306; Biological Abstracts, Vol. 44, No. 4, Abst. No. 15592. 1963.

The development of the movements of the pike embryo was observed from fertilization to hatching. The effects of temperature, O₂, and CO₂ were studied. Kymography and time photography were used. Two stages were identified in the development of embryonic motor activity: protoplasmic (preneural), and neuromuscular motor activity. In the first stage the whole egg cell moved within its cell membrane, due to changes in the shape of the yolk sac brought about by the contraction of the periblast. At the end of the first half of gastrulation, the egg cell rotated about its axis, but rotation ceased at the end of gastrulation. The protoplasmic mechanism of motor activity gradually disappeared and was replaced by rapidly developing neuromuscular movements. The neuromuscular movements appeared initially as tonic flexing of the trunk, and later as movements accompanied by changes in the position of the embryo within the membrane. The rise and fall of temperature were accompanied by corresponding strengthening and weakening of the movements. Changes in the gaseous content of the water affected neuromuscular activity, but had no effect on protoplasmic motor activity. (Courtesy NSF (PL 83-480) 1963)

6501. Dogel', V. S. 1958. PARASITOFUNA AND ENVIRONMENT. SOME PROBLEMS ON THE ECOLOGY OF PARASITES OF FRESH-WATER

FISH. (PARAZITOFUNA I OKRUZHAYUSHCHAYA SREDA. NEKOTORYE VOPROSY EKOLOGII PARAZITOV PRESNOVODNYKH RYB.) Leningradskii Gosudarstvennyi Universitet: Leningrad. 9-54, 336-337; Referat. Zhur., Biol., 1959, No. 52508; Biological Abstracts, Vol. 44, No. 4, Abst. No. 16944. 1963.

A discussion of the dependence of parasitofauna of fresh-water fish on the condition of the host and on the environment, and new data on the effect of the chemical and hydrological properties of the water reservoir on the parasitofauna of fish. As the fish ages, its parasitofauna gets richer both in quality and quantity. Sometimes the parasitofauna are almost completely changed with age. This is caused by a change in the character of the food and the place of habitation. With time, the parasitofauna of fish change due to changes in the chemical and trophic properties of the water reservoirs. The parasitofauna is more uniform and poorer in phytophagous fish than in planktophages and predatory fish. The anadromous migration of fish is accompanied by more or less marked changes in their parasitofauna, the sea parasites becoming replaced by fresh-water ones. In relict fish there is a general impoverishment of parasitofauna, as in fish which dwell near the area boundary. (Courtesy NSF (PL 83-480) 1963)

6502. Sadkovskaya, O. D. 1958. CHANGES IN THE BLOOD LEUKOCYTE COUNT OF CARP INFECTED WITH DACTYLOGYRUS EXTENSUS (SOLIDUS). (IZMENENIE LEIKOTSITARNOI FORMULY KROVI KARPA PRI INVAZII DACTYLOGYRUS EXTENSUS (SOLIDUS).) Akad. Nauk SSSR: Moscow. 320-321; Referat. Zhur., Biol., 1959, No. 84456; Biological Abstracts, Vol. 44, No. 4, Abst. No. 16957. 1963.

Blood leukocyte count of carp infected with the monogenetic trematode, D. extensus, revealed that the number of monocytes, neutrophils and polymorphonuclear leukocytes increases. The sexually mature parasites provoke the increase of neutrophils and indicate as toxic reaction in the fish. Monocytes increase, up to 20.9% in heavily infected fish. The number of polymorphonuclear cells increases from 1.5% in slightly infected fish up to 7.9% in heavily infected ones. (Courtesy NSF (PL 83-480) 1963)

6503. Bulkley, Ross V. (Box 60, Nukualofa Tongatabu, Tonga). 1963. NATURAL VARIATION IN SPOTTING, HYOID TEETH COUNTS, AND COLORATION OF YELLOWSTONE CUTTHROAT TROUT, SALMO CLARKI LEWISI GIRARD. U. S. Fish and Wildlife Service Special Scientific Report-Fisheries No. 460, 11 pp.

Differences in hyoid teeth and spotting counts among samples from four related populations of Yellowstone cutthroat trout, Salmo clarki lewisi Girard, reached species and subspecies levels as defined by some workers. Body coloration varied significantly among fish in six spawning runs of Yellowstone Lake, Wyoming. The use of coloration,

spotting, and hyoid teeth counts in cutthroat trout for taxonomic purposes needs re-evaluation. (Auth.)

6504. Greenberg, Arnold E. (Sanitation & Radiation Lab., California Dept. of Public Health, Berkeley). 1964. PLANKTON OF THE SACRAMENTO RIVER. Ecology, Vol. 45, No. 1, pp. 40-49.

Plankton and associated water-quality conditions in the Sacramento River from Keswick Reservoir to Mayberry Slough were studied over a period of 15 months from the spring of 1960 to the summer of 1961. Monthly plankton samples were collected at 22 fixed river stations. There was a gradual increase in the total number of plankters as the water progressed downstream. At the Isleton Bridge, about 35 miles downstream from Sacramento, a major plankton pulse occurred. A statistical evaluation of the number of plankters and chemical and physical parameters of water quality and movement showed that water temperature was the single most important factor affecting plankton development in that region of the river unaffected by tidal action. Water temperature, stream flow, and biochemical oxygen demand accounted for about 60% of the variations in plankton numbers. The diatoms Synedra, Cyclotella, and Melosira were generally the predominating algae. Blue-green and other algae were never relatively numerous, although at some downstream stations green algae, usually Ankistrodesmus, were numerous in midsummer. Zooplankton never represented a significant portion of the total plankton. (Auth.)

6505. John, Kenneth R. (Franklin and Marshall Coll., Lancaster, Pennsylvania). 1964. SURVIVAL OF FISH IN INTERMITTENT STREAMS OF THE CHIRICAHUA MOUNTAINS, ARIZONA. Ecology, Vol. 45, No. 1, pp. 112-119.

Fish in intermittent streams of the Chiricahua Mountains, Arizona, are subjected annually to environmental extremes of drought and flash floods.

The natural life span for most Rhinichthys osculus in the Chiricahua Mountains is less than 3 years. None was found to reach 4 years.

High mortality rates during summer drought must be interpreted, in part, as an acceleration of death among older fish since most fish are expected to die before they are 3 years old. Among younger fish, drought directly elevates the mortality rate.

Mortalities during a drought are caused directly by the disappearance of water and indirectly by starvation of the fish which are crowded into reduced habitat with inadequate food.

Flash floods are an important cause of mortality among fish of the year if they occur while the fish are very small. The greatest potential loss of fish of the year occurs in late summer when the initial flash flood induces major reproduction and is then followed by another flash flood.

Flash floods are not a significant cause of mortality among older fish.

Temporary waters may persist in some sections through a period of wet years. The populations of

fish inhabiting them are derived from upstream sections during a flash flood. All fish that were located in downstream temporary sections in the spring of 1960 were one-year-olds.

Temperatures do not rise to lethal levels in any of the flowing streams. In exposed shallow isolated pools, the temperatures may become lethal for older fish, but not for fish of the year.

Predators play a minor role. Only one, the garter snake, *Thamnophis cyrtopsis*, is common and apparently important.

Although fish populations are greatly reduced by a year of drought, there is no immediate threat of their local extinction. (Auth.)

6506. Zhadin, V. I., and S. V. Gerd. 1961. FAUNA AND FLORA OF THE RIVERS, LAKES, AND RESERVOIRS OF THE U. S. S. R. (REKI, OZERA I VODOKHRANILISHCHA SSSR. IKH FAUNA I FLORA.) Moskva, 1961; Translation: Office of Technical Services (U. S. Dept. of Commerce, Washington 25, D. C., \$6.25), OTS 63-11166, 626 pp. 1963.

This book is an introduction to the hydrobiology of inland waters of the U. S. S. R.

The authors have striven to give in generalized form a large amount of data, accumulated by Russian hydrobiologists in more than a century of research and to be found in special publications.

The first chapter of the book deals with the development of knowledge on fresh-water life and its scientific investigation. Chapter two gives a brief general outline of the flora and fauna of rivers and lakes. The third chapter discusses the fundamental laws governing life in an aquatic environment. Chapters four, five, and six describe the life of animal and vegetable organisms in the rivers, lakes, and artificial reservoirs of the U. S. S. R.

In chapter seven the authors discuss basic problems of the maximum exploitation of the resources of U. S. S. R. inland waters feasible only after thorough investigation.

6507. Lauff, George H., and Kenneth W. Cummins (Dept. of Zool., Univ. of Michigan, Ann Arbor). 1964. A MODEL STREAM FOR STUDIES IN LOTIC ECOLOGY. Ecology, Vol. 45, No. 1, pp. 188-191.

The model stream described has wide application in studies of lotic ecology, and the substrate tray system is of particular value in the experimental determination of the factors affecting the microdistribution of benthic organisms. Experiments conducted with nymphs of the stone fly, *Perlesta placida* (Hagen), demonstrated their preference for coarse particle sizes. In addition, silt in the interstices of the finer sediments appears to be unfavorable for the nymphs but makes less difference in the coarse substrates where some filling between the particles may actually be preferable. (Authors)

6508. Sreenivasan, A. (Fresh Water Biol. Sta., Bhavanisagar, S. India). 1964. FISH MORTALITY IN AN UPLAND LAKE IN MADRAS STATE.

Ecology, Vol. 45, No. 1, pp. 197-198.

An instance of fish mortality in a cold upland lake in India is reported. The carp died from anoxia resulting from the mixing of the poorly oxygenated narrow epilimnion with the anaerobic hypolimnion where hydrogen sulfide and high amounts of carbon dioxide were present. (Auth.)

6509. Schoffman, Robert J. (Spalding Institute, Peoria, Illinois). 1964. SUMMARY OF THE AGE AND RATE OF GROWTH OF GAME FISH IN REELFOOT LAKE, TENNESSEE, FROM 1937 THROUGH 1961. Journal of the Tennessee Academy of Science, Vol. 39, No. 1, pp. 11-15.

The growth rate of game fish in Reelfoot Lake shows a decrease in both length and weight since commercial fishing was abolished in 1955. Since 1955 more fish in the lower age groups are being taken.

Crappies are the most important game fish at the present time; however, the number of small crappies is increasing to the extent that fifty to a hundred less than six inches in length can be caught in several hours.

Largemouth black bass, like crappies, have been decreasing in length and weight. The majority caught are in the lower age groups, and the number being caught is decreasing. Bass have been protected since 1939 with no improvement in fishing.

For the improvement of sport fishing and the catching of larger fish, the most important thing for the present is to reduce the number of small fish, especially crappies. A fish management program is needed that will determine the species and the number of fish that could be taken commercially to bring back and keep the lake in balance. (Auth.)

6510. Johnston, R. (Marine Lab., Aberdeen, Scotland). 1964. SEA WATER, THE NATURAL MEDIUM OF PHYTOPLANKTON. II. TRACE METALS AND CHELATION, AND GENERAL DISCUSSION. Journal of the Marine Biological Association of the United Kingdom, Vol. 44, No. 1, pp. 87-109.

Assays and mixed culture experiments prove that the supply of chelating substances is frequently the most crucial aspect of phytoplankton nutrition in sea water. Experimental results, theoretical considerations and tentative calculations show that this supply is controlled by the stability of the trace metal chelates and in the sea may be mediated by certain unknown minor components of the dissolved organic matter.

The results of Parts I and II are considered together and show how sea water quality is closely related to the chelation of trace metals, mainly iron, and various other factors, such as the hydrographic origin, depth, and time of year.

6511. Rice, A. L. (Marine Biol. Sta., Port Erin, Isle of Man, England). 1964. OBSERVATIONS ON THE EFFECTS OF CHANGES OF HYDROSTATIC PRESSURE ON THE BEHAVIOR OF SOME MARINE ANIMALS. Journal of the Marine Biological

Association of the United Kingdom, Vol. 44, No. 1, pp. 163-175.

An apparatus and experimental method for the investigation of the effects of changes of pressure on the behavior of marine animals is described.

In 43 of a total of 53 species examined in this apparatus definite responses to abrupt pressure changes of 1000 millibars or less have been observed, increased pressure generally causing increased activity and movement upwards or towards the light, and decreased pressure causing decreased activity and movement downwards or away from the light. The relative importance of light and gravity in the orientation of these movements is generally correlated with the degree of development of the light and gravity receptors in the species concerned.

The possible significance of these pressure responses in nature is discussed and it is suggested that pressure may be an important factor affecting the distribution of marine plankton, particularly during the hours of darkness. (Auth.)

6512. Morgan, F. (Radiobiological Lab., Hamilton Dock, Lowestoft, Suffolk, England). 1964. THE UPTAKE OF RADIOACTIVITY BY FISH AND SHELLFISH. I. $^{134}\text{CAESIUM}$ BY WHOLE ANIMALS. Journal of the Marine Biological Association of the United Kingdom, Vol. 44, No. 1, pp. 259-271.

The uptake of ^{134}Cs by 36 species of marine and fresh-water fish and shellfish has been measured, and for selected species has been shown to depend on a power of the weight. For plaice, lobster, and eel, over thousandfold ranges of weight, the uptake varies according to $w^{0.78}$. The times taken to reach half-equilibrium concentrations vary according to a value between $w^{0.25}$ and $w^{0.29}$, e.g. for a 100-fold increase in weight there is a 3.5-fold increase in half-value time. (Auth.)

6513. Hynes, H. B. N. (Univ. of Liverpool, England). 1963. IMPORTED ORGANIC MATTER AND SECONDARY PRODUCTIVITY IN STREAMS. Proceedings of the XVI International Congress of Zoology, Vol. 4, pp. 324-329.

The author concludes that at least a very large part of the productivity of all running waters is based on photosynthesis which takes place elsewhere, and that without this source of allochthonous organic matter the inherent instability of running water and its consequent inability to grow much in the way of plants, except in specially favored places, would cause it to be almost a desert habitat.

6514. Hoar, William S. (Dept. of Zool., Univ. of British Columbia, Vancouver, Canada). 1963. THE ENDOCRINE REGULATION OF MIGRATORY BEHAVIOR IN ANADROMOUS TELEOSTS. Proceedings of the XVI International Congress of Zoology, Vol. 3, pp. 14-20.

There is ample evidence of intensified activity in several of the endocrine glands (pituitary,

thyroid, gonads, and adrenal cortex) during the reproductive period. At present, however, there is little valid evidence for a specific hormonal triggering of the anadromous migration. The endocrine effects may be very general metabolic ones; the change from a feeding resident fish to a roaming prebreeding animal could be a part of the general maturation process, quite distinct from the altered endocrinology even though the two occur simultaneously. Fundamental correlations between specific hormones and the anadromous migration remain to be demonstrated. Evidence of a special endocrinology during the smolt transformation is adequate. Changes in the pituitary, the thyroid, and the adrenal are well documented with resultant alterations in growth, general metabolism, and the metabolism of electrolytes. At present, however, there is no evidence that the hormones do more than change a resident feeding fish into an active roaming and frequently more pelagic animal which then encounters a different set of environmental stimuli. This is a similar conclusion to that reached in connection with the spawning migration. In both cases, the interaction of the animal with its environment depends on the endocrinology but there is little evidence that any specific hormone controls any particular reaction. At present these conclusions are very tentative. In evolution, hormones have sometimes become related to patterns of behavior in specific ways but until the classical methods of endocrinology have been more rigorously applied to the problem and until more examples are carefully examined further generalizations are unwarranted.

6515. Schnitzlein, H. N. (Univ. of Alabama Medical Center, University). 1963. CORRELATION OF HABIT AND STRUCTURE IN THE FISH BRAIN. Proceedings of the XVI International Congress of Zoology, Vol. 3, pp. 229-232.

Relations between the morphological structure and functions of parts of the nervous system, their exaggeration and abeyance in different fishes and their representation in related forms are discussed.

6516. Holmgren, Uno (Zool. Inst. Uppsala Univ., Sweden). 1963. NEUROSECRETION IN TELEOST FISHES: THE CAUDAL NEUROSECRETORY SYSTEM. Proceedings of the XVI International Congress of Zoology, Vol. 3, pp. 234-237.

In the hypothalamic system four stages in the transformation of ordinary nerve cells into neurosecretory ones have been described: (1) Ordinary nerve cells; (2) ordinary nerve cells with stainable granules and vacuoles in the cell plasma; (3) true neurosecretory cells with traces of secretion both in the cell body and axon, which divides and terminates in a place of storage; the cells have dendrites; (4) resembles type 3 but is lacking dendrites. When trying to classify the neurosecretory cells of the caudal neurosecretory system in teleosts using the terminology above, it can be noted that the urophyseal neurosecretory system seems to contain: (1) Cells resembling ordinary nerve cells;

(2) true neurosecretory cells which in many respects have retained some of the characters of the ordinary nerve cell. Thus, the cells have dendrites, neurofibrils, etc., but nevertheless show many signs of neurosecretory activity, e. g. a large irregular nucleus with indications of material emitted from the nucleus into the cytoplasm, an accumulation of colloid material in the cell body and herring body like structures along the axon; (3) the studies of the fine structure of the urophysis spinalis have shown that there are apparently neurosecretory cells, which have retained their production of 'neurohumors,' judging from the presence of 'synaptic vesicles' together with neurosecretory vesicles. This would represent a transitional stage between 2 and 3 according to the terminology above. The most common neurosecretory cell type is lacking dendrites and would thus represent type 4.

6517. Slater, Daniel W. (6949 Chevy Chase Way, Sacramento, California). 1963. WINTER-RUN CHINOOK SALMON IN THE SACRAMENTO RIVER, CALIFORNIA, WITH NOTES ON WATER TEMPERATURE REQUIREMENTS AT SPAWNING. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 461, 9 pp.

Salmon specialists throughout the Pacific Coast indicate that the winter-run chinook salmon is restricted to California's Sacramento River system. The characteristics and habits of the race are unique in the following respects: Fresh-water holding period, December to April; spawning period, April into July. The up-migration is concurrent with the late segments of the fall run, but the adults are distinguishable by the green condition of the gonads. The down-migration is concurrent with that of the spring-run fry, but the migrants are 2-inch or larger fingerlings. Evidence is lacking to determine whether there is an earlier down-migration of fry. The race appears to hold great promise as a stock to be introduced into areas where May-August temperatures are 42.5°-57.5° F, for it supports superb angling during the fresh-water holding period. Water temperatures in May through August are seen as the factor limiting the natural extension of the range of the race. (Auth.)

6518. Loeb, Howard A., and William H. Kelly (Fish Lab., DeBruce, New York). 1963. ACUTE ORAL TOXICITY OF 1,496 CHEMICALS FORCE-FED TO CARP. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 471, 124 pp.

Results of a screening program to find chemicals that will selectively kill carp are presented. None of the 1,496 chemicals reported on proved suitable for incorporation into a bait (on a solubility-palatability basis), but the force-feeding tests do provide the only extensive acute oral toxicity data on fish available today.

6519. McGregor, E. A. (U. S. Dept. of Interior, Washington, D. C.). 1963. PUBLICATIONS ON FISH PARASITES AND DISEASES, 330 B. C. -

A. D. 1923. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 474, 84 pp.

These references were collected in 1924, but until now this collection has been available only in manuscript form. Because of the current increased interest in this field, this bibliography is being issued to make it more generally accessible. It includes the earliest known references to fish parasites (330 B. C.) as well as a nearly complete collection up to 1924.

6520. Buckley, Burton R. (Northwestern State Coll., Natchitoches, Louisiana), and James E. Sublette. 1964. CHIRONOMIDAE (DIPTERA) OF LOUISIANA. II. THE LIMNOLOGY OF THE UPPER PART OF CANE RIVER LAKE, NATCHITOCHES PARISH, LOUISIANA, WITH PARTICULAR REFERENCE TO THE EMERGENCE OF CHIRONOMIDAE. Tulane Studies in Zoology, Vol. 11, No. 4, pp. 151-166.

Cane River Lake is a shallow impoundment of what was once a channel of Red River. It has a well-developed zone of emergent vegetation. While it does not develop stable thermal stratification, it does show occasional oxygen depletion from bottom water during summer months. The principal components of the benthos are Oligochaeta, Chironomidae, and *Chaoborus*, in that order. Forty-six species of chironomids were collected with emergence of some species occurring during every month of the year. Greatest emergence periods coincided with lowest larval population levels. Number of species by site of emergence was thirty-four from vegetation, thirty-six from littoral benthos, and three from the profundal benthos. Intersexuality of *Polypedium digitifer* Townes is reported. Greatest period of diel emergence was between five and eleven P. M. (Authors)

6521. Phillips, Arthur M., Jr., A. V. Tunison, and George C. Balzer (U. S. Bur. Sport Fish. & Wildl., Washington, D. C.). 1963. TROUT FEEDS AND FEEDING. U. S. Fish and Wildlife Service, Circular 159, 38 pp.

This circular is a combination of "Trout Feeds and Feeding" (Fishery Leaflet 423 of the Fish and Wildlife Service) and Parts I and V of "The Nutrition of Trout," a series of articles in the "Progressive Fish-Culturist." Major topics include general feeding methods, rearing capacities of hatchery units, ingredients for trout diets and the use of production charts in hatchery operations.

6522. Fitch, John E. (California Dept. Fish and Game, Terminal Island). 1963. A REVIEW OF THE FISHES OF THE GENUS *PLEURONICHTHYS*. Los Angeles Co. Mus., Contrib. in Sci., (76): 1-33.

The genus *Pleuronichthys* is confined to the North Pacific. Five of the six species, *coenosus*, *decurrens*, *verticalis*, *ritteri*, and *ocellatus*, inhabit American coastal waters, and *cornutus* lives along Asiatic shores. All members of this

specialized genus, commonly called turbot, are characterized by having the dorsal fin originating on the blind side.

In this review, more than 5,700 individuals were examined and identified. A key was constructed for distinguishing the species, and variations and relationships are discussed.

Each species is illustrated with a photograph and its distinguishing characters, color, geographic distribution, maximum size, food, and synonymy are outlined. In addition, various life-history aspects are discussed where information was available.

The hornyhead and Asiatic turbot (verticalis and cornutus) appear to be the most highly specialized, and the C-O turbot (coenosus), the most primitive. (Auth.)

6523. Biostatistical Section (California Dept. of Fish and Game, Terminal Island). 1964. THE CALIFORNIA MARINE FISH CATCH FOR 1962. Calif. Dept. Fish and Game, Fish Bull. 125, 45 pp.

The 1962 commercial fish catch is arranged in 18 tables by months, statistical areas, and major ports. Imported and domestic species are shown separately in tables. The dollar value of each species to the fishermen by major ports and statewide is listed. Additional tables record common and scientific names, number of licensed fishermen by area of residence, and number of fishing boats by length. Partyboat sport catch 1953 to 1962, and live bait catch for 1962 comprise the final two tables. (E. C. G.)

6524. Ebert, Earl E. (California Dept. of Fish and Game, Terminal Island). 1964. UNDERWATER TAGGING GUN. Calif. Fish and Game, 50(1): 29-32.

The construction and use of an underwater fish-tagging gun is described and illustrated. (Auth.)

6525. Young, Parke H. (California Dept. of Fish and Game, Terminal Island). 1964. SOME EFFECTS OF SEWER EFFLUENT ON MARINE LIFE. Calif. Fish and Game, 50(1): 33-41.

A number of fish and mollusk species collected 1956-1958, near sources of sewer effluent in Santa Monica Bay, at White Point, and in Los Angeles-Long Beach Harbor were dead or abnormal. Abnormalities ranged from tumors, exophthalmic eyes, and lip papillomas to significant changes in weight-length relationships. Pollution was the only factor that could be associated with all of these observations. Clinical, experimental, and literary evidence supporting the pollution theory was obtained. (Auth.)

6526. Smith, J. Gary (California Dept. Fish and Game, Menlo Park). 1964. NOTES ON THE LIFE HISTORY AND A DESCRIPTION OF THE SHARP-NOSE SEAPERCH, PHANERODON ATRIPES (JORDAN AND GILBERT). Calif. Fish and Game, 50(1): 42-47.

There have been increasing reports of this species, following a long period of scarcity. Recently captured specimens have given new information on inshore and offshore habitat, maturity, and food habits. A northerly extension, size range, and meristic data are also given. (Auth.)

6527. Jensen, Paul T. (California Dept. of Fish and Game, Sacramento). 1964. LANDINGS ESTIMATES OF CALIFORNIA'S MARINE RECREATIONAL SALMON FISHERY. Calif. Fish and Game, 50(1): 48-52.

Estimates for four years have been obtained by a combination of random sampling plans, voluntary logs kept by skiff facility operators, and legally required logs maintained by partyboat operators. Comparison of these with estimates produced by postcard questionnaires demonstrates unreliability of latter as measures or indices of landings of this fishery. The partyboat fishery accounts for a fairly constant two-thirds of total landings. Official California ocean sport landing estimates are presented for the period 1947 through 1962. (Auth.)

6528. Rawstron, R. R. (California Dept. of Fish and Game, Sacramento). 1964. SPAWNING OF THREADFIN SHAD, DOROSOMA PETENENSE, AT LOW WATER TEMPERATURES. Calif. Fish and Game, 50(1): 58.

Threadfin shad, Dorosoma petenense, were observed spawning in Pine Flat Lake, Fresno County, and Millerton Lake, Fresno/Madera Counties, California, when surface water temperatures were 58° and 64° F, respectively. Previously published information indicates that spawning most frequently occurs at approximately 70° F. (Auth.)

6529. Hoffman, Glenn L. (Eastern Fish Disease Lab., Leetown, (P. O. Kearneysville) West Virginia). 1963. PARASITES OF FRESH-WATER FISH. I. FUNGI. 1. FUNGI (SAPROLEGNIA AND RELATIVES) OF FISH AND FISH EGGS. U. S. Fish and Wildlife Service, Fishery Leaflet 564, 6 pp.

The morphology, identification, life cycle, transmission, pathogenicity, geographical range, control, and treatment of fungus diseases of fish and fish eggs are discussed briefly in this leaflet. An annotated bibliography is included.

6530. Beamish, F. W. H. (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, N. B.), and P. S. Mookherjee. 1964. RESPIRATION OF FISHES WITH SPECIAL EMPHASIS OF STANDARD OXYGEN CONSUMPTION. I. INFLUENCE OF WEIGHT AND TEMPERATURE ON RESPIRATION OF GOLDFISH, CARASSIUS AURATUS L. Canadian Journal of Zoology, Vol. 42, No. 2, pp. 161-175.

Standard oxygen consumption of goldfish was estimated in relation to weight and temperature from simultaneous measurements of routine oxygen uptake and spontaneous activity. The relation between weight and standard oxygen consumption was expressed as a logarithmic linear regression.

For a given shift in temperature, the proportionate change in standard oxygen consumption appears to be independent of weight. The mean slope of the regressions was found to be 0.850.

The standard rate of a 100-g goldfish increased linearly, on a semilogarithmic grid, over the temperature range of 10 to 35° C. The estimates found in the present study were less than the lowest applicable values that could be found in the literature.

The average routine rate of oxygen consumption suggests that goldfish display a considerable amount of spontaneous activity despite the elimination of external stimuli. (Authors)

6531. Beamish, F. W. H. (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, N. B.). 1964. RESPIRATION OF FISHES WITH SPECIAL EMPHASIS ON STANDARD OXYGEN CONSUMPTION. II. INFLUENCE OF WEIGHT AND TEMPERATURE ON RESPIRATION OF SEVERAL SPECIES. Canadian Journal of Zoology, Vol. 42, No. 2, pp. 177-188.

Standard oxygen consumption, as estimated by simultaneously measuring spontaneous activity and oxygen consumption, for five species of freshwater fishes, was measured in relation to weight and temperature. The fish studied were brown trout, Salmo trutta; brook trout, Salvelinus fontinalis; common white sucker, Catostomus commersoni; brown bullhead, Ictalurus nebulosus; and carp, Cyprinus carpio. When expressed on a logarithmic grid, standard oxygen uptake increased linearly with weight for all species. The proportionate change in standard oxygen consumption for a given change in temperature appears to be independent of size within each species. The mean slope values of the regressions found for brown trout, brook trout, common white sucker, brown bullhead, and carp are 0.877, 1.052, 0.864, 0.925, and 0.894, respectively.

The standard rates of oxygen consumption found in the present investigation are less in most cases than the lowest applicable values that could be found in the literature.

Spontaneous activity, expressed in terms of average oxygen consumption over the standard rate, varied with temperature. Maximum spontaneous activity for a given species coincided roughly with its preferendum temperature. (Auth.)

6532. Beamish, F. W. H. (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, N. B.) 1964. SEASONAL CHANGES IN THE STANDARD RATE OF OXYGEN CONSUMPTION OF FISHES. Canadian Journal of Zoology, Vol. 42, No. 2, pp. 189-194.

The standard rate of oxygen consumption for brook and brown trout acclimated to 10° C and exposed to natural daylight varied seasonally. For male brook trout, standard oxygen consumption increased from a low of 30 mg/kg hour during March and April to a maximum of 63 mg/kg hour during the late fall spawning period. The standard rates of the females approximated those for males. For male brown trout, standard oxygen uptake increased from a value of approximately 20 mg/kg

hour during the winter and spring months to a high of roughly 30 mg/kg hour during the fall spawning period. Little change was observed in the standard oxygen consumption of female brown trout. (Auth.)

6533. McBride, J. R., U. H. M. Fagerlund, M. Smith, and N. Tomlinson (Tech. Res. Lab., Fish. Res. Bd. of Canada, Vancouver, B. C.). 1964. OLFACTORY PERCEPTION IN JUVENILE SALMON. II. CONDITIONED RESPONSE OF JUVENILE SOCKEYE SALMON (ONCORHYNCHUS NERKA) TO LAKE WATERS. Canadian Journal of Zoology, Vol. 42, No. 2, pp. 245-248.

Sockeye salmon smolts were conditioned to distinguish between waters from two natural sockeye nursery systems, Great Central Lake (from which the smolts were obtained) and Cultus Lake. The attractant from each water was volatile, but that from Great Central Lake was the more readily volatilized of the two. Volatile material from Great Central Lake water was collected and shown to evoke a response in the group of fish conditioned to whole Great Central Lake water. (Authors)

6534. Chudova, Z. I. 1961. THE ROLE OF VITAMINS A AND B₁ IN THE REARING OF SALMON FRY. (ROL' VITAMINOV A I B₁ V VYRASHCHIVANII MOLODI LOSOSYA.) Tr. Nauchn.-Issled. Inst. Rybn. Khoz. Latviisk. SSR 3. 421-429; Referat. Zhur., Biol., 1962, No. 9158; Biological Abstracts, Vol. 44, No. 5, Abst. No. 17795. 1963.

Lack of vitamins A or B₁ in fish food leads to retardation of growth. Vitamin-free diets caused a decrease in the number of blood-forming elements, as well as a drop in Hb concentration (avitaminosis A, 31.5%; avitaminosis B₁, 28%; control, 40%). There was a decrease in the number of lymphocytes and increase in monocytes and polymorphonuclear leucocytes. Outward appearance and behavior of young fish underwent a change. Transfer of experimental fish to a rich diet abolished avitaminosis. Cultivation of salmon fry for 1-1 1/2 months on a diet containing twice as many vitamins as the standard diet had a beneficial effect. Subsequently this diet produced hypervitaminosis which led to inhibition of growth, poorer food utilization, and alteration of blood structure. Viability, however, remained high.

6535. Kirpichnikov, V. S. 1962. HYBRIDIZATION OF POND CARP WITH WILD CARP. (GIBRIDIZATSIYA KARPA S SAZONOM.) Pishchepromizdat: Moscow. 160-169; Referat. Zhur., Biol., No. 9155; Biological Abstracts, Vol. 44, No. 5, Abst. No. 17808. 1963.

Basic methods of selection were: a system of crossing (according to linear selection with inter-linear crossing) which excludes close inbreeding; intensive selection, particularly during the first year of life, setting aside for breeding purposes an amount less than or equal to 0.2-1.0%; establishment of breeding conditions favorable to the development of the best pedigree characteristics; establishment of uniform conditions for the entire stock

from which selection is made; examination of the descendants in order to select the best among them. Hybrids of the third generation were found to have good commercial qualities. Bibliography includes 21 references.

6536. McNeil, William John. 1963. MORTALITY OF PINK AND CHUM SALMON EGGS AND LARVAE IN SOUTHEAST ALASKA STREAMS. Dissert. Absts. 23(12 Pt. 1): 4489-4490; Biological Abstracts, Vol. 44, No. 5, Abst. No. 17815. 1963.

6537. Wood, William F. (California Dept. Fish and Game, Terminal Island). 1964. PARTYBOAT LOGS SHOW HOW SKINDIVERS FARED DURING 1960, 1961, and 1962. Calif. Fish and Game 50(2): 114-117.

Skindiver catch logs received by the California Department of Fish and Game are summarized to show species taken by year and area, catch-per-diver, and catch-per-diver-hour. Logs showed that 9,050 divers caught 21,543 fish, mollusks, and crustaceans comprising 24 kinds during the 3-year period. (Auth.)

6538. Abrosimova, N. M., and R. I. Tatarskaya (Inst. Radiation and Phys.-Chem. Biol., Acad. Sci. USSR, Moscow, USSR). 1963. THE PROPERTIES OF ADENOSINE TRIPHOSPHATASE IN VARIOUS FRACTIONS OF FISH EGGS. (O SVOISTVAKH ADE-NOZINTRIFOSFATAZY V RAZLICHNYKH FRAKTSIYAKH YAITSA RYB.) Biokhimiya 28(3): 486-496; Biological Abstracts, Vol. 44, No. 5, Abst. No. 17982. 1963.

As shown by experiments with ethylene diamine tetraacetate, fish egg ATPase is inactive in absence of bivalent cations. After removal of metal ions from the enzyme protein by $(\text{NH}_4)_2\text{SO}_4$ treatment and subsequent dialysis the highest enzymatic activity was found upon addition of Mn^{++} and Mg^{++} ; the activating effect of Ca^{++} is less distinct while Ba^{++} and Sr^{++} do not activate the enzyme at all. Fractionation of eggs by mechanical separation into membranes and egg content, differential centrifugation of homogenates in sucrose or isolation of a myosin-like protein did not yield any fraction in which ATPase was activated by Ca^{++} to a higher degree than by Mg^{++} . It was found that egg inorganic pyrophosphatase is activated by Mg^{++} but not by Mn^{++} . This observation along with the fact that ADP breakdown is slight under the conditions which favor the ATPase effect warrants the conclusion that one terminal phosphate group is split off from ATP by egg ATPase. The data obtained do not support the hypothesis advanced by some authors that the role of Ca^{++} in fertilization is primarily concerned with egg ATPase activation. (Authors)

6539. Lyubitskaya, A. I. 1956. THE EFFECT OF VARIOUS PARTS OF THE VISIBLE AREAS OF THE SPECTRUM ON THE DEVELOPMENT STAGE OF FISH EMBRYOS AND LARVAE. (VLIYANIE RAZLICHNYKH UCHASTKOV VIDIMOY CHASTI SPEKTRA NA STADII RAZVITIYA EMBRYONOV I

LICHINOK RYB.) Zool. Zhur. 35(12): 1873-1886; Referat. Zhur., Biol., 1959, No. 91441; Biological Abstracts, Vol. 44, No. 5, Abst. No. 19785. 1963.

The effect of light on the development of fish of the salmon family was studied. In various conditions (in daylight, in the dark, exposure to light of various wave lengths), differences were observed in the development rate and in the survival percentage of the embryos. The effect of the examined factors was not identical for the different development stages of the embryos of one species or for the corresponding stages in the development of various fish species. (Courtesy NSF (PL 83-480) 1963)

6540. Domurat, Jerzy (Coll. Agric., Olsztyn, Poland). 1961. DELAY IN THE DEVELOPMENT OF RAINBOW TROUT (SALMO IRIDEUS GIBB.) EMBRYOS DEVELOPING IN WATERLESS MEDIUM. Zool. Polon. 10(2): 89-94; Biological Abstracts, Vol. 44, No. 5, Abst. No. 19782. 1963.

The above experiment seems to indicate that the egg of the rainbow trout is not a system entirely closed to water. The development of these eggs in paraffin oil, i. e. in a medium completely devoid of water, proceeds from the first blastomeres to the closure of the blastopore, although it is retarded by 120 hours. The claims of many authors (Bogucki 1930; Daya 1956; Gray 1920, 1932; Hayes 1949; Krogh and Ussing 1937; Kronfeld and Schemnitzky 1929; Zotin 1955) that the eggs of salmonids do not take in water from the external medium during embryonic development (at least up to the moment of the appearance of pigment in the embryo's eyes, as claimed by Krogh and Ussing 1937) need certain revision. The tardiness in the development of embryos which is observed in waterless medium seems to indicate that the water from the external medium takes part in the processes of morphogenesis. (Auth.)

6541. Zotov, A. F. 1958. ANTIBACTERIAL PROPERTIES OF THE ORGANS AND TISSUES OF FRESH-WATER FISH. (ANTIBAKTERIAL'NYE SVOISTVA ORGANOV I TKANEI PRESNOVODNYKH RYB.) Voprosy Ikhtiol. 10. 157-161; Referat. Zhur., Biol., 1959, No. 71801; Biological Abstracts, Vol. 44, No. 5, Abst. No. 20516. 1963.

The relation of fish organs to cultures of Escherichia coli, Bacillus subtilis and penicillin- and streptomycin-resistant strains of Staphylococcus aureus were investigated. Antibacterial properties were found in 6 fish species. The fish organs and tissues showed antibacterial influence of gram-positive and gram-negative bacteria. The most persistent and evident antibacterial influence was found in the organs and tissues of the burbot, bleak, and pike. Antibacterial principles were not found in the gills, muscles, or intestines. No seasonal pattern of the antibacterial properties of fish tissue and organs could be established. (Courtesy NSF (PL 83-480) 1963)

6542. Hildemann, W. H., and R. L. Walford (Sch. Med., Univ. California, Los Angeles). 1963.

ANNUAL FISHES: PROMISING SPECIES AS BIOLOGICAL CONTROL AGENTS. Jour. Trop. Med. and Hyg. 66(7): 163-166; Biological Abstracts, Vol. 44, No. 5, Abst. No. 21201. 1963.

Development of insect resistance to pesticides and the toxic hazards of such chemicals to man have become increasing problems that focus attention on the need for biological control through organisms, parasitic or predacious, on arthropod vectors. Our purpose is to describe a group of "annual" fishes that hold unusual promise for control of mosquitoes and other aquatic invertebrates. The special merit of these fishes lies in their capacity to survive and multiply in impermanent water where other species would perish. Annual fishes occupy a wide range of temperate and tropical habitats where the water frequently disappears at least once a year. The population survives until the next wet season in the form of eggs buried in the soil. These eggs may be concentrated, transported, and dispersed in slightly damp peat. Ripe eggs hatch within a few hours after reintroduction to water. The voracious young are hardy, mature rapidly, and show high fertility. (Authors)

6543. Schiffman, R. H. 1961. PRELIMINARY STUDIES ON THE ELIMINATION OF STRONTIUM BY TROUT. U. S. Atomic Energy Comm. Res. and Develop. Rept. HW-69500. 81-86; Biological Abstracts, Vol. 44, No. 6, Abst. No. 21851. 1963.

A method to evaluate the pathways of strontium excretion from rainbow trout was developed. Results of two experiments indicate that 6% to 7% of the injected dose is in the urine, 3% to 4% in the gut, and 50% to 75% remains in the fish after 22 hours. This would infer that 15% to 40% of the injected dose is transported out of fish via the gills and/or the skin. (Auth.)

6544. Pfeiffer, Wolfgang. 1961. THE FEAR REACTION IN FISH AND THE SOURCE OF THE MATERIAL CAUSING FEAR. (ÜBER DIE SCHRECKREAKTION BEI FISCHEN UND DIE HERKUNFT DES SCHRECKSTOFFES.) Helgolander Wiss. Meeresuntersuchungen 8(1): 193-194; Biological Abstracts, Vol. 44, No. 6, Abst. No. 21900. 1963.

6545. Cassie, R. Morrison (New Zealand Oceanog. Inst., Dept. Sci. and Indust. Res., Wellington, New Zealand). 1963. MULTIVARIATE ANALYSIS IN THE INTERPRETATION OF NUMERICAL PLANKTON DATA. New Zealand Jour. Sci. 6(1): 36-59; Biological Abstracts, Vol. 44, No. 6, Abst. No. 22011. 1963.

Two techniques of multivariate analysis (component analysis, and discriminant analysis) are examined with a view to their use in interpretation of quantitative plankton data. Both methods are applied to a specific example, a horizontal sampling traverse from Cook Strait into Wellington Harbor on an incoming tide. The data incorporate sample counts of six plankton species and records of temperature and salinity. Component analysis

indicates that four species have a common pattern of variation which is correlated with salinity. The first component incorporates 50% of the total variance and nearly all the correlation with salinity. Of the total variance 43% is accounted for by regression on salinity, or alternatively 41% can be accounted for on the hypothesis that two numerically different plankton populations have been sampled, representing, respectively, Cook Strait and Harbour water. Discriminant analysis, using two or more species, is found to give little better separation of the two populations than would be achieved by selecting a single species as a discriminator. An elementary explanation of the theory of component analysis is given in the appendix. (Auth.)

6546. Kriss, A. E., M. N. Lebedeva, S. S. Abyzov, and I. N. Mitskevich. 1958. MICROORGANISMS AS INDICATORS OF HYDROLOGICAL PHENOMENA IN SEAS AND OCEANS. (MIKROORGANIZMY KAK INDIKATORY GIDROLOGICHESKIKH YAVLENII V MORYAKH I OKEANAKH.) Zhur. Obshchei Biol. 19(5): 397-413; Referat. Zhur., Biol., 1959, No. 91757; Biological Abstracts, Vol. 44, No. 6, Abst. No. 22025. 1963.

The possibility of determining some hydrological phenomena in seas and oceans is indicated: boundaries of streams, contiguity between river and sea waters and thermowedges can be outlined by changes in the heterotrophic bacterial population. Studies of waters of the Arctic, Indian, and Pacific Oceans are presented as a confirmation of this hypothesis. (Courtesy NSF (PL 83-480) 1963)

6547. Wlodek, Stanislaw (Inst. Inland Water Fish., Olsztyn, Poland). 1962. THE EFFECT OF ORGANIC FERTILIZERS ON THE INTENSITY OF METABOLISM AND CIRCULATION OF FOOD MATERIALS IN RESERVOIRS. (WPLYW NAWOZENIA ORGANICZNEGO NA NASILENIE I OBIEG MATERII W ZBIORNIKACH WODNYCH.) Roczn. Nauk Rolniczych Ser B. Zootech. 81(2): 251-274; Biological Abstracts, Vol. 44, No. 6, Abst. No. 22065. 1963.

The use of manure is effective in counteracting the nitrogen deficit of water reservoirs by creating suitable conditions for natural accumulation. This is in conformity with Hofer's thesis on the usefulness of so-called nitrogenless fertilization of waters. The accumulation of nitrogen in fertilized reservoirs proceeds unevenly, following variations in nitrogen in fertilized or periodic intensification of denitrification. Manuring a reservoir is an efficient and durable means of preventing free CO₂ deficiency. However, organic fertilization acts selectively on only those algae that assimilate CO₂ in its free form. Biological oxygen demand (BOD) by organic fertilizer has a decisive influence on the oxygen conditions in the water and must be considered to prevent an excessive oxygen deficit. Organic fertilizer has two effects on the circulation of food in water: greater development of green plants and omission of a trophic link. Horse and pig manures have specific advantage in acting upon metabolism in water. The first intensifies development of primary production,

the accumulation of nitrogen and the development of zooplankton. The second is marked by a lower BOD, thereby causing lower oxygen deficit; furthermore, pig manure is apt to create remarkably favorable conditions for the development of Chironomidae larvae. Limnaea stagnalis as a control of excess green algae and Chironomidae as reducing agents of organic debris proved disappointing in improving the circulation of food. This was due to the susceptibility of organisms of this link to parasitic invasion. (Auth.)

6548. Götting, Klaus-Jürgen (Zool. Inst., Univ. Giessen, Giessen, W. Germany). 1961. THE BASES OF PROPAGATION AND FERTILITY DETERMINATION IN MARINE TELEOSTEANS. (BEITRÄGE ZUR KENNNTNIS DER GRUNDLAGEN DER FORTPFLANZUNG UND ZUR FRUCHTBARKEITS-BESTIMMUNG BEI MARINEN TELEOSTEERN.) Helgolander Wiss. Meeresuntersuchungen 8(1): 1-41; Biological Abstracts, Vol. 44, No. 6, Abst. No. 22856. 1963.

The ovaries of ten species of marine teleosts are investigated by methodically combining quantitative counts and histological treatment. The structure includes: connective tissue, pigmentary layer, ring and longitudinal musculature, and germinal epithelium. The oogonia develop into oocytes of the 1st order representing a reserve stock from which a group of about 20% emerges annually to grow into an egg deposit. The development of the oocytes may be divided into four cytological stages. The nucleus, situated centrally at first, leaves the cell center at stage 4. The extrusion of nuclear substances enables the cytoplasm to accumulate the enormous quantity of yolk. The chromosomes are visible until the end of the first growth phase. During this time the first maturation division is initiated. During the second growth phase DNA cannot be found. It reappears only shortly before the maturation divisions. There is no "zona radiata" to be found in the teleosts investigated, though similar structures do appear: the "stratum radiatum" as a passing formation in the cytoplasm and the "cortex radiata" in the integument layers. The egg integument is built up from the interior, and not from the follicle. The conceptions "short-spawning period" - "long-spawning period" are specified distinctly. (Auth.)

6549. Barr, W. A. (Usher Inst., Edinburgh, Scotland). 1963. THE ENDOCRINE CONTROL OF THE SEXUAL CYCLE IN THE PLAICE, PLEURONECTES PLATESSA (L.). I. CYCLICAL CHANGES IN THE NORMAL OVARY. Gen. and Comp. Endocrinol. 3(3): 197-204; Biological Abstracts, Vol. 44, No. 6, Abst. No. 22889. 1963.

Techniques are described for the removal of the pituitary gland and for the force-feeding of experimental fish. Using these methods, post-operative survivals of more than one year were obtained. The histology of the ovary and its cyclical changes are described, and the origin and functional significance of corpora atretica are discussed. (Auth.)

6550. Barr, W. A. (Usher Inst., Edinburgh, Scotland). 1963. THE ENDOCRINE CONTROL OF THE SEXUAL CYCLE IN THE PLAICE, PLEURONECTES PLATESSA (L.). II. THE ENDOCRINE CONTROL OF OOGENESIS. Gen. and Comp. Endocrinol. 3(3): 205-215; Biological Abstracts, Vol. 44, No. 6, Abst. No. 22890. 1963.

Hypophysectomy has no effect on the germ cells of immature plaice, but in adults it stops the growth and maturation of the oocytes, causing their conversion to corpora atretica so that only oogonia and primary oocytes remain in the ovary of long-term operated specimens. Evidence is presented which suggests that oviposition is also under pituitary control. The oocytes remaining in the ovary after hypophysectomy can be stimulated to grow by injecting extracts of plaice pituitary glands. Oviposition has also been induced by the injection of such extracts and by other gonadotropins. (Auth.)

6551. Barr, W. A. (Usher Inst., Edinburgh, Scotland). 1963. THE ENDOCRINE CONTROL OF THE SEXUAL CYCLE IN THE PLAICE, PLEURONECTES PLATESSA (L.). III. THE ENDOCRINE CONTROL OF SPERMATOGENESIS. Gen. and Comp. Endocrinol. 3(3): 216-225; Biological Abstracts, Vol. 44, No. 6, Abst. No. 22891. 1963.

Spermatogenesis in the normal plaice is a cyclical process, the testis being reconstituted after spawning by the mitosis of reserve spermatogonia. Meiosis begins in autumn and spermiation takes place in March. Spermatogenesis is inhibited when fish are hypophysectomized during the summer, but evidence is presented which suggests that the process, once started, can continue for some time in the absence of the pituitary gland. Hypophysectomy does not prevent spermiation. (Auth.)

6552. Dyk, Vatslav. 1963. PIGMENT VARIABILITY IN TROUT. (IZMENCHIVOST' OKRASKI FORELEL.) Priroda (USSR) 52(6): 107; Biological Abstracts, Vol. 44, No. 6, Abst. No. 22973. 1963.

The article describes vivid and varying pigmentation of trout from Carpathian mountain streams. Specifically, from the stream Brusturanka, a tributary of the Tereshva River. Oxygen deficiency in the water is suspected of possible influence on trout pigmentation, in addition to factors normally affecting it. (B. Le B.)

6553. Bianki, V. L. (State Univ., Leningrad, USSR). 1963. ROLE OF CEREBELLUM IN AFFERENTATION OF THE SWIM BLADDER OF FISH. (RETSEPTSIYA PLAVATEL'NOGO PUZYRYA RYB I MOZZHECHOK.) Fiziol. Zhur. SSSR 49(4): 494-502; Biological Abstracts, Vol. 44, No. 6, Abst. No. 23090. 1963.

Dilatation of the swim bladder by a balloon inserted through a surgical fistula was studied as a conditional and unconditional stimulus in 89 carp. Simple conditioned reflexes could be acquired by pairing of swim bladder stimulation with electric shock: mild and strong stimulation, and continuous and intermittent stimulation could also be differentiated. Differentiation of weak and strong stimuli

could not be demonstrated after removal of the labyrinth. After ablation of the cerebellum, conditioned reflexes could not be acquired for 2-5 days in 6 fish. Other fish tested after longer postoperative periods did develop conditional reflexes with difficulty. Removal of the anterior cerebral cortex had no effect on these conditioned reflexes in 4 fish studied. (E. D. L.)

6554. Eichler, O., and A. Parah. (Edited by.) 1963. HANDBOOK OF EXPERIMENTAL PHARMACOLOGY. SUPPLEMENT. 17TH VOL. ALKALINE-EARTH METAL IONS. PART 1. ISOLATED SYSTEMS. (HANDBUCH DER EXPERIMENTELLEN PHARMAKOLOGIE. ERGÄNZUNGSWERK. SIEBZEHNTER BAND--TEIL 1. IONS ALKALINER METALLE. TOME 1. SYNTHESE ISOLÉS.) Springer-Verlag: Berlin, 574 pp.; Biological Abstracts, Vol. 44, No. 6, Abst. No. 23408. 1963.

This supplement in the French language by Zenon-Marcel Bacq contains both an author and subject index. Each chapter contains an extensive bibliography. Chapter headings include: Importance of alkaline-earth metal ions in biology; Physical chemistry of alkaline-earth ions; Effect of alkaline-earth ions on simple enzyme systems in vitro; Alkaline-earth metals and blood coagulation; Effect of alkaline-earth ions on polyenzymatic metabolic processes; Distribution of Ca and Mg between the cell and its medium; Alkaline-earth ions and microorganisms; Effect of alkaline-earth ions in invertebrates; Effect of alkaline-earth ions on cells, cellular structures or isolated tissues; Physiologic and pharmacologic action of alkaline-earth ions on nerve fibers; Effect of alkaline-earth ions on the cells of the central nervous system; Effect of alkaline-earth cations on neuromuscular transmissions and synapses; The alkaline-earth ions and striated muscle; Alkaline-earth ions and cardiac muscle; Effect of alkaline-earth ions on smooth muscle; Effect of alkaline-earth ions on blood cells; Effect of alkaline-earth ions on the viability and motility of the spermatozoa of homeotherms and fish; Cationic equilibria. (J. G. S.)

6555. Scarpelli, Dante G., Marie H. Greider, and Walter J. Frajola (Dept. Pathol., Ohio State Univ., Columbus, Ohio). 1963. OBSERVATIONS ON HEPATIC CELL HYPERPLASIA, ADENOMA, AND HEPATOMA OF RAINBOW TROUT (SALMO GAIRDNERI). Cancer Res. 23(6 Pt. 1): 848-857; Biological Abstracts, Vol. 44, No. 6, Abst. No. 23676. 1963.

Morphologic and biochemical features of non-neoplastic livers were compared with those of spontaneous hepatoma (hepatic carcinoma) in rainbow trout. More florid degenerative changes and lipochrome deposits were encountered in non-neoplastic livers of hatchery-reared trout than in those of wild trout of identical age. Cirrhosis was encountered only rarely. The majority of hepatomas were well differentiated. Metastases were encountered in only four of 28 tumor-bearing fish. Histochemical studies showed increased cytoplasmic

RNA and decrease to absence of glycogen in tumor cells. In five hepatomas there was an extracellular accumulation of protein which contained arginine and tyrosine. Electron microscopy of the tumor cells revealed hypertrophy of granular endoplasmic reticulum and Golgi apparatus and the accumulation of granules and amorphous material in the cytoplasm. The plasma proteins of trout with hepatoma were increased two- to threefold. The serum electrophoresis patterns showed increase of four protein components normally present in plasma of teleosts and a fifth component with a greater mobility than serum albumin. A comparison of enzyme patterns of non-neoplastic livers with adenomas and hepatomas indicates that neoplastic liver cells not only possess all the enzymes present in normal liver but augmented activity of many of the enzymes. Decreased activity in tumor cells was obtained only for succinic dehydrogenase, acid phosphatase, and glucose-6-phosphatase. Morphologic and biochemical characteristics of hepatoma in rainbow trout suggest that they should be classified as minimal-deviation tumors. On the basis of enzyme patterns adenomas were indistinguishable from hepatomas. (Authors)

6556. Polyanskii, Yu. I. 1958. PARASITOFUNA AND ENVIRONMENT. SOME PROBLEMS OF ECOLOGY OF SEA-FISH PARASITES. (PARAZITOFUNA I OKRUZHAYUSHCHAYA SREDA. NEKOTORYE VOPROSY EKOLOGII PARAZITOV MORSKIKH RYB.) Leningradskii Gosudarstvennyi Universitet: Leningrad 55-89, 337-338; Referat. Zhur., Biol., 1959, No. 52512; Biological Abstracts, Vol. 44, No. 6, Abst. No. 25446. 1963.

Factors influencing the parasitofauna of sea fish are investigated. Salinity and depth of water are considered environmental factors of secondary importance. In the depth of tropical seas parasites known from fish of northern seas were observed. The infection of fish decreases with depth. The parasitofauna of sea fish depends on the mode of life, food composition, and age of the host. Most fresh-water fish are usually infected with parasites which develop directly, while sea fish are infected with parasites whose intermediate hosts are small planktonic copepods. The parasites which have direct development appear only after the young fish come in contact with older fish. The difference in the parasitofauna of local schools is well marked in sea fish; thus, specific parasites are excellent indicators of such schools. A thorough investigation of the parasites of sea animals should be made to ascertain their developmental cycles. (Courtesy NSF (PL 83-480) 1963)

6557. Bailey, Reeve M., and William J. Richards (Dept. Cons., Cornell Univ., Ithaca, New York). 1963. STATUS OF POECILICHTHYS HOPKINSI FOWLER AND ETHEOSTOMA TRISELLA, NEW SPECIES, PERCID FISHES FROM ALABAMA, GEORGIA, AND SOUTH CAROLINA. Occas. Papers Mus. Zool. Univ. Michigan 630. 1-21; Biological Abstracts, Vol. 44, No. 6, Abst. No. 25711. 1963.

Diagnosis and synonymy are given for subgenus

Oligocephalus within Etheostoma, followed by redescription of E. hopkinsi and descriptions of E. h. binotatum from the Savannah River system of Georgia and South Carolina; and E. (Psychromaster) trisella from Cowans Creek in Alabama. (A. K. W.)

6558. Gosline, William A. (Mus. Zool., Univ. Michigan, Ann Arbor). 1963. CONSIDERATIONS REGARDING THE RELATIONSHIPS OF THE PERCOPSIFORM, CYPRINODONTIFORM, AND GADIFORM FISHES. Occas. Papers Mus. Zool. Univ. Michigan 629. 1-38; Biological Abstracts, Vol. 44, No. 6, Abst. No. 25714. 1963.

This paper is based upon study of alizarin-stained, partly dissected specimens of 2 spp. of Clupeiformes, 2 of Beloniformes, 2 of Gadiformes, 2 of Percopsiformes, 8 of Cyprinodontiformes, 2 of Mugiliformes, and 2 of Perciformes. The 1st part takes up the relationships and systematic position of the percopsiform fishes, comparing the anatomy of the cranium, nasal structure and brain, sensory canals and related bones, jaw mechanism and associated structures, gill arches, pectoral girdle, pelvic fins and girdle, vertical fins and fin supports, etc. It is concluded that the Percopsiformes are a scopeliform derivative. Section 2 deals with the cyprinodontoid fishes, with similar detailed comparisons of structure. Lists are given of characters in which they resemble the atherinids rather than the amblyopsoids, characters in which they resemble the latter more than the former, and characters in which they resemble neither. The discussion indicates that the resemblances to the Atherinidae may be due to convergent evolution. The cyprinodontoids appear to represent a specialized offshoot of the amblyopsoid stock. Finally, a key is given to distinguish Gadiformes, Percopsiformes, and Cyprinodontiformes, and suborders Amblyopsoidei and Cyprinodontoides within the latter. A chart of possible relationships is shown. (A. K. W.)

6559. Calovich, F. E., and B. A. Branson (Kansas State College, Pittsburg). 1964. THE SUPRAETHMOID-ETHMOID COMPLEX IN THE AMERICAN CATFISHES, ICTALURUS AND PYLODICTIS. The American Midland Naturalist, Vol. 71, No. 2, pp. 335-343.

Comparison of the supraethmoid-ethmoid complexes of the species of Ictalurus and Pylodictis shows these structures to be important taxonomic characters. The catfishes discussed fall into four main groups: (1) Ictalurus punctatus, I. lupus, I. pricei, and I. platycephalus all have narrowly elongated supraethmoid stems. The cornua are compact with deep, narrow, median clefts and well-defined extensions. Other similarities involve elongation and curvature of the supraethmoid. (2) Ictalurus furcatus, I. catus, and I. nebulosus all have short, broadened supraethmoid stems and broadly branched cornua. I. furcatus and I. catus have broad clefts, whereas that of I. nebulosus is shallow to nearly lacking.

(3) In I. melas and I. natalis the complex is broad. The median cleft of I. melas is broad and shallow in sexually mature specimens and exceedingly shallow in others. I. natalis has a shallow and broad cleft which bears broadly rounded bony extensions. (4) Pylodictis olivaris is unique in possessing a broadened, flattened ethmoidal stem, broadly branched cornua and a very wide cleft. (Authors)

6560. Schwartz, Frank J. (Chesapeake Biol. Lab., Solomons, Maryland). 1964. EFFECTS OF WINTER WATER CONDITIONS ON FIFTEEN SPECIES OF CAPTIVE MARINE FISHES. The American Midland Naturalist, Vol. 71, No. 2, pp. 434-444.

Observations are presented of the effects of winter water conditions on the survival, behavior, and color patterns of 15 species of marine fishes, comprising 11 families and 80 specimens held in aquaria with continuous flowing water. Only weakfish were found to float when dead, all others remained on the bottom of the test aquaria. The behavior patterns exhibited prior to death were as varied as the species studied. These observations may help to explain aggregations of dead fishes that are often detected accidentally during winter sampling. The largest kill of the study specimens occurred during the 15-20 December, 1962, cold snap. Field observations from Georgia to Texas reported kills of several of the same species. (Auth.)

6561. Svetovidov, A. N. (Zool. Inst., Academy of Sciences, Leningrad, USSR). 1964. SYSTEMATICS OF THE NORTH AMERICAN ANADROMOUS CLUPEOID FISHES OF THE GENERA ALOSA, CASPIALOSA, AND POMOLOBUS. Copeia, 1964, No. 1, pp. 118-130.

The osteological and other differential characters of the species of the European and North American clupeoid nominal genera Alosa, Caspialosa, and Pomolobus have been studied. Because the previous arrangement of these fishes into three genera does not reflect their relationships, they are united here under one name, Alosa Linck. The distinction between Alosa and Caspialosa is very slight and does not warrant subgeneric status. The differences between Alosa and Pomolobus are considerably more significant, and Pomolobus is defined as a subgenus of Alosa. (Auth.)

6562. Raney, Edward C., and Royal D. Suttkus (Dept. of Cons., Cornell Univ., Ithaca, New York). 1964. ETHEOSTOMA MOOREI, A NEW DARTER OF THE SUBGENUS NOTHONOTUS FROM THE WHITE RIVER SYSTEM, ARKANSAS. Copeia, 1964, No. 1, pp. 130-139.

E. moorei is described from 228 specimens in six series from tributaries of the Little Red River. Much of its limited range was impounded and habitat destroyed by the recent completion of Greers Ferry Dam. It is geographically isolated from the six described species of Nothonotus found in the Ohio, Tennessee, and Alabama river systems. Sexual dimorphism is marked; the male is brightly

colored and larger. E. camurum and E. rufilineatum are its closest relatives and the three species constitute a species group. In coloration, the males of moorei and camurum are similar, while the females of moorei and rufilineatum are close. E. moorei differs from both in having fewer vertebrae and rays in both dorsals, the anal, and the pectoral fins. (Authors)

6563. Needham, Paul R. (Dept. of Zool., Univ. California, Berkeley), and Richard Gard. 1964. A NEW TROUT FROM CENTRAL MEXICO: SALMO CHRYSOGASTER, THE MEXICAN GOLDEN TROUT. Copeia, 1964, No. 1, pp. 169-173.

A new trout from southwestern Chihuahua, Mexico, is described. Salmo chrysogaster resembles rainbow trout in some characters, cutthroat trout in others, and neither in some characters. It is rainbow trout-like in its body shape, short upper jaw and snout, rainbow stripe, fine spotting, and lack of basibranchial teeth. Cutthroat trout characters possessed by chrysogaster are the "cutthroat" mark, bright coloration, and nine pelvic rays. Cutthroat trout typically have fewer vertebrae and pyloric caeca than rainbow trout, but in its low number of vertebrae and caeca, chrysogaster stands unique in the genus Salmo. The known range comprises an area of 35 by 45 miles in the Fuerte, Sinaloa, and Culiacan river systems in southwestern Chihuahua and northwestern Durango.

6564. Edsall, Thomas A. (U. S. Bur. Comm. Fish., Biol. Lab., Ann Arbor, Michigan). 1964. FEEDING BY THREE SPECIES OF FISHES ON THE EGGS OF SPAWNING ALEWIVES. Copeia, 1964, No. 1, pp. 226-227.

The spawning activities of alewives in the Kalamazoo are presented. Other fish were present at every spawning act observed during daylight. Observations during darkness failed to disclose any aggregations of other fishes accompanying the spawning alewives. Although larger spottail shiners and alewives (and possibly larger emerald shiners) may feed only lightly on alewife eggs, small spottail shiners and alewives appear to be effective egg consumers.

6565. Morrow, James E. (Dept. of Wildl. Mgmt., Univ. of Alaska, College). 1964. POPULATIONS OF PIKE, ESOX LUCIUS, IN ALASKA AND NORTHEASTERN NORTH AMERICA. Copeia, 1964, No. 1, pp. 235-236.

The pike of Siberia from the Ob River in the west to the Anadyr River in the east are assigned to the subspecies Esox lucius baicalensis. The basis for the assignment is said to be the greater number of dorsal and anal fin rays and lateral-line scales in the Siberian pike. In an attempt to establish the Alaskan form, meristic characters of 31 pike from the Tanana and upper Yukon drainages were compared with 52 northeastern specimens from the Cornell University collection. The counts of pectoral rays and mandibular pores were virtually identical in their mean values in the two

samples. Statistically significant differences occurred between mean values of the other counts, but the differences are about what might be expected from two widely separated populations of the same form.

6566. Hunsaker, Don, II, and R. W. Crawford (San Diego State Coll., San Diego, California). 1964. PREFERENTIAL SPAWNING BEHAVIOR OF THE LARGEMOUTH BASS, MICROPTERUS SALMOIDES. Copeia, 1964, No. 1, pp. 240-241.

During April 1962, 31 brood bass including adult male and female Micropterus salmoides salmoides and M. s. floridanus were planted in a 3-acre pond in San Diego County, California.

The bass were afforded a choice of spawning sites which included these possibilities: sand; small, medium, or large gravel; any of these 4 substrates with or without protective boulders; and water depths of 18 in. and 4 ft.

Of the 14 nests observed, 12 were associated with large boulders or pilings and 2 in relatively unprotected areas. Selection of substrate size ranged from fine sand to large fragments but only 4 nests were in shallow water, and only 4 were in unprotected areas. These data indicate a selection for deeper water in nest building, and also suggest that the most important factor in the selection of a spawning site for these bass is the availability of suitable protection in the immediate vicinity of the nest.

An interesting factor in this study was the introduction of the brood bass into the lagoon during the peak of spawning activities.

It is a distinct possibility that these fish selected spawning sites with protection available because of the new environment.

6567. Bachop, William Earl (Ph. D. Thesis, Ohio State Univ., Columbus). 1963. FEULGEN MICROPHOTOMETRY OF PERIBLAST NUCLEI IN THE MUSKELLUNGE EMBRYO (CLUPEIFORMES: ESO-CIDAE). Dissert. Absts., Vol. 24, No. 7, pp. 3021-3022.

Relative DNA contents of nuclei in periblast, the syncytium enveloping the yolk of the Esox masquinongy ohioensis Kirtland embryo, were measured by two-wave length Feulgen microphotometry. In an embryo incubated 95 hours, 25 periblast nuclei and 20 non-periblast nuclei were measured. In an embryo incubated 163 hours, 40 periblast nuclei and 20 non-periblast nuclei were measured. At both ages, periblast nuclei measured fell into a unimodal distribution whose average DNA content approximated four times that of non-periblast nuclei. Siblings hatched after 238 hours. Elongation (up to 125 microns) and contiguity of periblast nuclei prevented measurement of the larger nuclei with the instrumentation available. Since immeasurable nuclei that exceeded in area those measured as octoploids seemed to have as great a dye intensity, their ploidy might be expected to exceed eight. Periblast nuclei smaller than those measured as octoploids were not unmistakably distinguishable from enlarged

(pre-mitotic) non-periblast nuclei and were not measured.

Observation of the three dimensional morphology of whole periblast nuclei *in situ*, and of their three dimensional relation to each other and to yolk, was made possible by the following sequence: aldehyde blockade, Feulgen processing, submerging embryo in oil in Petri dish, and examination with 44x or 95x objective immersed in oil. Aldehyde blockade prior to Feulgen processing effected a difference in color of yolk and overlying nuclei. Examination of whole embryo in oil allowed resolution ordinarily obtainable only with sectioned specimens on slides.

In whole periblast nuclei of a 95 hour embryo, various Feulgen-positive aggregations--rods, spirals, figure 8's, amorphous--were superimposed on a diffuse Feulgen-positive background within intact "nuclear membranes." Such dye aggregations were two to eight times longer than either mitotic configurations or interphase diameters of non-periblast nuclei. Whether such dye aggregations represented "heterochromatin" or endopolyploidization was not decided. No such dye aggregations were seen in periblast nuclei in identically processed 163 hour embryos.

In enlarged periblast nuclei, chromatin filaments of late prophase thickness were seen in whole, Feulgen-processed nuclei and in sectioned, Harris hematoxylin stained nuclei, within intact "nuclear membranes." Spindles and asters were never seen in enlarged periblast nuclei, with several fixatives and dyes, although they were seen in non-periblast nuclei ten microns away in sections or in whole nuclei *in situ*.

Using photographs of whole periblast nuclei *in situ* on a 95 hour embryo, 1601 nuclei were plotted onto a hollow sphere, which was subsequently spread flat as a map. Taking into consideration uncounted and lobulated nuclei, it is thought, as a first approximation, the actual number of nuclei in the periblast lay between 1500 and 2000. Generally, where nuclei were small, they were numerous; where nuclei were large, they were less numerous.

Intensity of yolk reddening with Feulgen processing varied inversely with the age of the embryo, implying a decrease in the amount of chromagen in yolk, or an alteration in its diffusibility, with age. Exposure of yolk and embryo to aniline hydrochloride for 36 hours before Feulgen processing blocked yolk reddening but not nuclear reddening. Time required for aniline hydrochloride to block yolk reddening varied inversely with the age of the embryo, again implying a decrease in amount of chromagen in yolk, or an alteration in its diffusibility, with age.

On the basis of its reactions with two Schiff reagents, basic fuchsin and azure-A, and with an aldehyde-coupling agent, aniline hydrochloride, the yolk chromagen was inferred to be a carbonyl group and/or an unsaturated lipid. This inference was substantiated somewhat by the fact that unblocked yolk exposed to ether, a lipid solvent,

did not redden during subsequent Feulgen processing. (Auth.)

6568. Brungs, William Aloysius, Jr., (Ph. D. Thesis, Ohio State Univ., Columbus). 1963. THE RELATIVE DISTRIBUTION OF MULTIPLE RADIO-NUCLIDES IN A FRESH-WATER POND. Dissert. Absts., Vol. 24, No. 7, p. 3023.

A plastic-lined pond containing 30,000 gallons of spring water and a sand substrate was used for this study. The test organisms were carp, *Cyprinus carpio*; bluegills, *Lepomis macrochirus*; snails, *Vivipara malleatus*; tadpoles of the bullfrog, *Rana catesbiana*; and two species of clams, *Anodonta grandis*, a thin-shelled species, and *Lampsilis radiata siloquoidea*, a thick-shelled species. Water and substrate samples were also collected and analyzed.

Four millicuries each of cobalt-60, zinc-65, strontium-85, and cesium-137 were added to the pond water several weeks after the test organisms had been introduced. Samples for baseline radiological data were collected several days before the start of the experiment, after which 10 complete sets of samples were collected over an 80-day period.

During the experiment numerous chemical, physical, and biological analyses were performed on the experiment pond water and also on a control pond. This information provided an indication of differences between the two pond waters.

There was an initial rapid loss of cobalt-60, zinc-65, and cesium-137 from solution. Cobalt-60 and zinc-65 were becoming associated with the suspended solids and cesium-137 was adsorbed onto the bottom sediments. Strontium-85 was gradually removed from solution. Only 8 percent of the cobalt-60, 4 percent of the zinc-65, and 5 percent of the cesium-137 remained in solution after 4 days. Sixty-four percent of the strontium-85 was in solution at this time.

More zinc-65 was found in biological samples than any of the other test radionuclides except in some hard parts fractions such as shell and bone in which strontium-85 activities were generally higher. The primary consumers, carp, snails, tadpoles, and clams, accumulated more of each radionuclide than did the predatory bluegill. In general, soft parts rapidly accumulated more activity than the hard parts but gradually lost it as radionuclide concentrations in the water decreased. Clam and snail shells and fish bone generally accumulated zinc-65 and strontium-85 for almost the duration of the experiment.

Carp, snails, and clams remaining after the final sampling from the pond were placed in continuously replenished, uncontaminated water for 3 weeks, but no detectable radionuclide loss was observed. During this time the water temperature was low, about 15° C less than during the experiment, and the metabolic activity of these test organisms was greatly reduced and any loss of radionuclides would, as a result, be inhibited.

Young clams and snails accumulated more

zinc-65 and strontium-85 than did adult individuals of these two groups. However, strontium-85 concentrations in the soft parts of clams were higher in the adults. (Auth.)

6569. Diaz, Enrique L. 1963. AN INCREMENT TECHNIQUE FOR ESTIMATING GROWTH PARAMETERS OF TROPICAL TUNAS, AS APPLIED TO YELLOWFIN TUNA (*THUNNUS ALBACARES*). Inter-American Tropical Tuna Comm. Bulletin, Vol. VIII, No. 7, pp. 383-405.

Growth rates of yellowfin tuna have been determined in previous studies by identifying year classes and following their modal progressions throughout their occurrence in the fishery. This technique may not be readily applied to other tropical tunas (e. g., skipjack) because, although modal lengths can be followed for a period of time, these may not represent identifiable year classes. To avoid the problem of identifying year classes and yet obtain estimates of the rate of growth, a method was devised, an increment technique, which measures the change in length per unit of time against mean body length.

Length-frequency data for the years 1951-1961 have been studied to determine the rate of growth of yellowfin tuna for the Eastern Tropical Pacific by means of the increment technique. To test the validity of this technique, results are compared with estimates of growth parameters for the same areas reported by Hennemuth (1961) and Davidoff (1963) whose studies were based on a knowledge of year classes.

The results of these analyses show that the use of the increment technique in the study of modal progressions of yellowfin tuna, without a knowledge of their age, gives a growth curve which is not very different from that derived when the year class composition is known. Some caution, however, must be exercised in the use of the technique when only a limited amount of data is available. It is likely, therefore, that this technique will prove of value in the study of the growth rate of the skipjack tuna where it has not yet been possible to assign ages, but where short-term series of modal progressions in the length-frequency data are apparent. (Auth.)

6570. Bauer, K. 1961. STUDIES ON THE EFFECTS OF PLANT-PROTECTIVE AGENTS ON FISH AND FISH-FOOD ORGANISMS. Mitt. biol. ZentAnst., Berlin, No. 105, 72 pp.; LitBer. Wass. Abwass. Luft u. Boden, 1962, 11, 41-42; Water Pollution Abstracts, Vol. 37, No. 1, Abst. No. 172. 1964.

The author has collected from a wide range of literature the results of investigations into the effect of plant-protecting agents (insecticides, fungicides, and herbicides) on fish and organisms used as fish food.

6571. Kayser, H., D. Lüdemann, and H. Neumann. 1962. ALTERATIONS IN NERVE CELLS IN FISH AND CRUSTACEANS CAUSED BY INSECTICIDES. Z. angew. Zool., 49, 135-148; LitBer. Wass. Abwass. Luft u. Boden, 1962, 11, 41; Water Pollution

Abstracts, Vol. 37, No. 1, Abst. No. 173. 1964.

The authors describe and give illustrations of the alterations caused in the nerve cells of fish and crustaceans by the action of a number of modern contact insecticides.

6572. Coutant, C. C. 1962. THE EFFECT OF A HEATED WATER EFFLUENT UPON THE MACRO-INVERTEBRATE RIFFLE FAUNA OF THE DELAWARE RIVER. Proc. Pa. Acad. Sci., 36, 58-71; Water Pollution Abstracts, Vol. 37, No. 1, Abst. No. 181. 1964.

The macroinvertebrate bottom fauna of riffle areas in a one-mile stretch of a relatively unpolluted part of the Delaware River (from just below the point of discharge of condenser water from Martin's Creek steam electric generating plant to Little Kaypush Rapids) was sampled using the Surber sampler several times, chiefly during the summer of 1959. In the maximally-heated stretch (20°-25° F above normal river temperature) on the Pennsylvania side the summer fauna experiences drastic reduction both in number of genera and numbers of individuals for sampling areas of 5 ft² compared with a control station located above the discharge in the same riffle. The standing crop biomass was reduced on average during July and August from 1.04 to 0.09 g per ft². A slight increase in the number and variety of organisms over the control was observed in a second riffle located approximately one mile below the discharge, but this may have no connection with the 2°-5° F increase over normal river temperatures observed here. Mid-winter and spring samplings indicate at least a partial repopulation of the maximally-heated zone during the spring periods of high water. Traverse samplings extending from the maximally-heated zone along the Pennsylvanian shore into deeper and cooler water indicate a tolerance limit for most of the fauna of 90°-95° F.

6573. Schulze, E. 1961. THE EFFECT OF WASTE WATERS CONTAINING PHENOL ON THE TASTE OF FISH. Int. Rev. Hydrobiol., 46, 419-426; LitBer. Wass. Abwass. Luft u. Boden, 1962, 11, 40; Water Pollution Abstracts, Vol. 37, No. 1, Abst. No. 182. 1964.

From the results of new and previously published experiments on the effect of phenols on the taste of fish, the author points out the discrepancy between results in the laboratory and in natural conditions. For his experiments flow-through tanks were used in which the phenol was added in small concentrations to the flowing water, thus avoiding loss by decomposition and adsorption. Experiments with pure phenol showed that the taste of the fish flesh was very little affected though phenol was accumulated in certain organs, especially in the liver and gills. Monochlorophenols, on the other hand, had a strong effect.

6574. English, J. N., G. N. McDermott, and C. Henderson. 1963. POLLUTIONAL EFFECTS OF OUTBOARD MOTOR EXHAUST--LABORATORY STUDIES. J. Wat. Pollut. Contr. Fed., 35, 923-

931; Water Pollution Abstracts, Vol. 37, No. 1, Abst. No. 184. 1964.

In view of the increasing popularity of recreational boating in the U. S. A., preliminary studies have been carried out on the polluting effects of the underwater exhaust of outboard motors. Low-horsepower motors were operated in tanks in the laboratory, using as fuel a mixture of regular grade, leaded gasoline and an outboard motor lubricating oil. Results of the experiments are given in tables and graphs and discussed. It was found that the average estimated concentration of various polluting materials in the water at an assumed extreme-critical situation is small, but in certain circumstances each increment must be considered if the sum of the sources of pollution produces an objectionable condition. As pollution by outboard motor exhaust may occur at or near the intake of a domestic water supply, there would be limited dilution and little time for natural self-purification to take place. The exhaust caused a marked odor in the water, and 180 lb. of carbon were required per mil. gal. of water to reduce the threshold odor to 1, but the polluting materials had little or no effect on the chlorine demand of the water or on coagulation and sedimentation. Unless adequate dilution is available, the polluted water was found to be toxic to fish, and even nontoxic concentrations caused tainting of fish flesh, but the toxicity of the polluted water decreased with ageing. It is planned to carry out field studies on the effects of pollution by outboard motors, with particular reference to the persistence or build-up of the pollutants.

6575. English, J. N., E. W. Surber, and G. N. McDermott. 1963. POLLUTIONAL EFFECTS OF OUTBOARD MOTOR EXHAUST--FIELD STUDIES. J. Wat. Pollut. Contr. Fed., 35, 1121-1132; Water Pollution Abstracts, Vol. 37, No. 2, Abst. No. 354. 1964.

In continuation of investigations on the polluting effect of the underwater exhaust from outboard motors, field studies were carried out on a privately-owned lake where outboard motor boats were used mainly for water skiing, a pond where outboard motors were operated by the research personnel, and a control pond. The effects on the quality of the water and the tainting of flesh of fish (bluegills) kept in liveboxes in the water were studied. Tainting of fish flesh was detectable at a combined fuel-use level of 8 gal. per mil. gal. of water and a daily fuel-use rate of 0.17 gal. per mil. gal. of water. The threshold odor number of the water began to increase when the amount of fuel used was between 0.5 and 1.5 gal. per mil. gal. of water. There was also an increase in the concentration of carbon-chloroform-extractable materials as a result of outboard motor operation, a maximum concentration of about 8 µg per liter being found for each gallon of fuel per mil. gal. of water.

6576. Nehring, D. 1962. LAUNDRY WASTE WATERS AND FISH. Dtsch. Fischztg, 9, 46-51; LitBer. Wass. Abwass. Luft u. Boden, 11, 37-38;

Water Pollution Abstracts, Vol. 37, No. 1, Abst. No. 186. 1964.

The author deals with the effects on fish of waste waters from laundries, with special reference to the effects of organic matter and detergents. The effect of detergents in removing the protective mucus film from skin, gills, and intestines, and the secondary effect on surviving fish of increased sensitivity to parasites and fungus, are discussed. Threshold values for the toxicity of different types of detergents, found by the author and other investigators, are given and the effect on the receiving stream of the high content of phosphates is considered.

6577. Dean, J. M., and R. F. Burlington. 1963. A QUANTITATIVE EVALUATION OF POLLUTION EFFECTS ON STREAM COMMUNITIES. Hydrobiologia, 21, 193-199; Water Pollution Abstracts, Vol. 37, No. 2, Abst. No. 328. 1964.

Biological surveys of polluted waters are often limited to qualitative observations, but it is possible to develop a quantitative relation between populations in various ecological habitats and so assess the effect of pollution. Such a quantitative relation is obtained by the coefficient of similarity, which is calculated from the frequency of distribution of the genera at the different stations and the mean density of the genera at each station. In an attempt to show that quantitative biological methods can be used in conjunction with water quality data to evaluate the condition of a water, a study was carried out on the Elkhart and St. Joseph Rivers near Elkhart, Ind. Chemical data indicated that pollution was present directly below a trade waste discharge, but showed no difference in water quality further downstream. The biological coefficient of similarity, however, indicated that the effluent had an effect on downstream stations. It is concluded that use of the coefficient of similarity to give a quantitative assessment of biological data can be useful in evaluating the effects of mild or periodic pollution on stream communities when water quality data are inconclusive.

6578. Fedorova, G. V. 1963. THE EFFECT OF WATER TEMPERATURE, AGE, AND SEX OF A FISH ON THE ABSORPTION AND ELIMINATION OF C-14. C. R. Acad. Sci. U.R.S.S., 150, 168-169; Nuclear Sci. Abstr., 1963, 17, 3268; Water Pollution Abstracts, Vol. 37, No. 2, Abst. No. 342. 1964.

Young guppies and adult male and female guppies (*Lebistes reticulatus*) were kept in water containing 20 µc of carbon-14 (in the form of acetic acid) per liter. After 30 days the accumulation coefficient (ratio of activity in the fish to activity in the water) was 121.4 for females, 72.5 for males, and 261.0 for young fish. The activity of adult fish kept at a temperature of 19°-21° C was 2.5-3.0 times greater than that of fish kept at 10°-16° C. When the contaminated fish were transferred to clean water, the residual activity after 20 days was 13.8-34 percent of the initial activity;

females eliminated radioactivity more rapidly than did the males.

6579. Harvey, R. S. 1963. UPTAKE OF RADIO-NUCLIDES BY FRESH-WATER ALGAE AND FISH. U. S. Atom. Energ. Comm., DPSPU-63-30-3, 12 pp.; Nuclear Sci. Abstr., 1963, 17, 3017; Water Pollution Abstracts, Vol. 37, No. 2, Abst. No. 344. 1964.

In order to select a suitable indicator species for routine environmental monitoring, concentrations of radioactive isotopes in fish (bluegill, bass, and catfish) in a nuclear reactor cooling-water pond were measured over a 9-month period. The bluegill, containing higher concentrations of zinc-65 and strontium-89, 90 and only slightly lower concentrations of caesium-134, 137, was selected. Data on uptake by algae were also obtained.

6580. Hibiya, T., and M. Oguri. 1961. GILL ABSORPTION AND TISSUE DISTRIBUTION OF SOME RADIONUCLIDES (CR-51, HG-203, ZN-65, AND AG-110M, 110) IN FISH. Bull. Jap. Soc. Sci. Fish., 27, 996-1000; Water Pollution Abstracts, Vol. 37, No. 2, Abst. No. 346. 1964.

Radioactive nuclides were used to study the rate of absorption of some heavy metals through the gills of the Japanese eel, Anguilla japonica. Zinc, mercury, chromium, and silver were absorbed at rates of $0.7-4.1 \times 10^{-6}$, $0.3-3.2 \times 10^{-5}$, $0.8-1.9 \times 10^{-8}$, and $1.2-4.2 \times 10^{-7}$ mg per hour, respectively. The distribution and accumulation of the nuclides in the body were studied by injecting the nuclides into the air bladder of goldfish. The results obtained differed with the different nuclides; zinc, mercury, chromium, and silver were accumulated abundantly by the intestine, kidney, head kidney, and liver, respectively.

6581. Rosa, H., Jr. (Edited by) (Fish. Biology Br., Food & Agric. Org. of the United Nations, Rome, Italy). 1963. PROCEEDINGS OF THE WORLD SCIENTIFIC MEETING ON THE BIOLOGY OF TUNAS AND RELATED SPECIES. FAO Fisheries Reports No. 6, Vol. 2, 975 pp.

This volume contains 34 corrected synopses of biological data on various species of tuna and related fishes which were distributed to the participants and to the contributors to the World Scientific Meeting on the Biology of Tunas and Related Species in La Jolla, California, 2-14 July 1962. The synopses include data on identity, distribution, bionomics and life history, populations, and exploitation.

6582. Bodenstein, G., and G. M. Bastgen. 1960. INVESTIGATIONS INTO THE TOXICITY OF SOME HERBICIDES FOR FISH. 10. ON THE TOXICITY OF MODERN PEST-DESTROYING AGENTS FOR FISH. Z. PflKrankh., 67, 150-153; Chem. Zbl., 1961, 132, 923; Water Pollution Abstracts, Vol. 36, No. 3, Abst. No. 518. 1963.

Tests with a number of commercial herbicidal preparations, including Dalapon, MCPA, CIPC,

and CMU, showed that most were less toxic to fish than the generally used insecticides.

6583. Dowden, B. F. 1962. TOXICITY OF COMMERCIAL WASTE-OIL EMULSIFIERS TO DAPHNIA MAGNA. J. Wat. Pollut. Contr. Fed., 34, 1010-1014; Water Pollution Abstracts, Vol. 36, No. 3, Abst. No. 520. 1963.

Waste-oil emulsifiers are in common use for the removal of oil and grease from structures and from water surfaces. It is usually claimed that these emulsifiers are nontoxic, but the author has carried out experiments on the toxicity of two of them to Daphnia magna. The emulsifiers used were designated according to their action on water--F (foaming) and W (white emulsion). It was found that crude oil was less toxic to Daphnia than either of the emulsifiers or the emulsions formed by them with crude oil in natural lake water or in reference dilution water; the toxicity of the crude oil is attributed to entrapment of the animals at the surface of the test solutions. With Emulsifier F, the 24-hour TL_m was found to be the same for both the emulsifier and the emulsion formed by it, but for all other TL_m periods the emulsion was more toxic than the emulsifier alone, probably as a result of the intimate contact of the emulsified oil with the test organisms. Different patterns of toxicity at successive TL_m periods are thought to be due to adjustment of the animals' metabolic processes to adverse conditions and to interaction between the emulsifier, crude oil, and the test medium components. Emulsifier W was the most toxic material tested and there was no difference between the toxicity of the emulsifier and of its emulsion; it is thought that this indicates that the toxic properties of the emulsifier itself caused all the mortality observed. Concentrations of this emulsifier greater than 10 ppm also killed small bluegills (Lepomis macrochirus) within 5 min.

6584. Olson, P. A., and R. E. Nakatani. 1962. REACTOR EFFLUENT MONITORING WITH SALMON, 1960-61. U. S. Atom. Energ. Comm., HW-72500, 144-147; Nuclear Sci. Abstr., 1962, 16, 3291; Water Pollution Abstracts, Vol. 36, No. 3, Abst. No. 528. 1963.

Studies have been carried out at Hanford, Wash., on mortality and growth of groups of young chinook salmon reared in water containing 0, 4, and 8 percent of reactor effluent. There was significantly greater mortality in the presence of 8 percent effluent. The accelerated rate of growth observed in the presence of 4 and 8 percent effluent is attributed to the increased temperature of the water.

6585. Ambühl, H. 1960. FISH POISONING. PRESERVATION OF SAMPLES AND FIRST COLLECTIONS. Schweiz. FischZtg, No. 7; LitBer. Wass. Abwass. Luft u. Boden, 1961, 10, 104; Water Pollution Abstracts, Vol. 36, No. 4, Abst. No. 670. 1963.

The author describes the methods of sampling and examination recommended in order to discover the cause of death of fish.

6586. Amlacher, E. 1961. THE EFFECT OF MALACHITE GREEN ON FISH, FISH PARASITES (ICHTHYOPHTHIRIUS, TRICHODINA), SMALL CRUSTACEANS, AND WATER PLANTS. Dtsch. Fischztg, 8, 12-15; LitBer. Wass. Abwass. Luft u. Boden, 1961, 10, 105; Water Pollution Abstracts, Vol. 36, No. 4, Abst. No. 671. 1963.

The author describes tests on the effect of malachite green on one-year carp, young rainbow trout, other fish, Daphnia, snails, and water plants, and of the amounts required to destroy various fish parasites. Trout could tolerate up to 0.2 mg per liter, and carp up to 0.9 mg per liter; Daphnia and water plants were not damaged by concentrations of 0.6 mg per liter and more, and snails showed no damage at 0.3 mg per liter. Use of malachite green on food fish should be avoided as in high concentrations it produces tumors.

6587. Alabaster, J. S., and R. L. Welcomme. 1962. EFFECT OF CONCENTRATION OF DISSOLVED OXYGEN ON SURVIVAL OF TROUT AND ROACH IN LETHAL TEMPERATURES. Nature, Lond., 194, 107; Water Pollution Abstracts, Vol. 36, No. 4, Abst. No. 672. 1963.

Experiments on the effect of low concentrations of dissolved oxygen on the survival of rainbow trout (Salmo gairdneri) and roach (Rutilus rutilus) at lethal temperatures are described. For both species of fish, the temperature corresponding to a survival period of 1000 min was reduced by 0.5° C by decreasing the concentration of dissolved oxygen from 7.4 to 3.8 ppm. Results are shown in graphs.

6588. Razumov, A. S. 1962. MICROBIAL INDICATORS OF ORGANIC POLLUTION OF WATER BY INDUSTRIAL EFFLUENTS. Microbiology, Moscow, 30, 764-768; Publ. Hlth Engng Abstr., 1962, 42, 233; Water Pollution Abstracts, Vol. 36, No. 4, Abst. No. 676. 1963.

The micro-organism Cladothrix, which is an indicator of organic pollution, can be distinguished from Sphaerotilus by its ability to utilize inorganic as well as organic sources of nitrogen. Cladothrix is commonly found in the waste waters of sugar refineries, plants manufacturing starch-syrup, alcohol, or synthetic rubber, paper mills and textile mills; it can also develop on petroleum carbon, on wastes of wood-processing plants, and on nontoxic concentrations of allyl oils. Assimilation of carbon is better from disaccharide than monosaccharide compounds and poorest from ethyl alcohol and organic salts. Cladothrix also differs from Sphaerotilus in reducing nitrates to nitrites in the presence of easily assimilated carbon, and in becoming impregnated with iron salts in a medium containing organic or inorganic iron compounds.

6589. Herry, S. 1959. POLLUTION OF RIVERS BY HEATED DISCHARGES. Bull. Centre belge Et. Document. Eaux, No. 46, 226-235; Water Pollution Abstracts, Vol. 36, No. 4, Abst. No.

686. 1963.

After discussing the effects of heated discharges on the temperature, and, consequently, on the concentration of dissolved oxygen, of receiving streams the author summarizes results obtained during investigations to determine the effects of heated discharges on the river Sambre, Belgium. Details are given of the effects of heated discharges on the various reaches examined. Results indicate that the temperature of the river water never exceeded 30° C, except in the immediate vicinity of discharges, and it is concluded, since variations exist between the theoretical and practical temperature curves, that there is rapid mixing of the water downstream of such outlets. Calculations show, however, that even with a river flow of 10 m³ per sec there will always be an oxygen deficiency in the river.

6590. Heintz, E. 1962. THE BEHAVIOR OF FISH UNDER THE INFLUENCE OF ODOROUS SUBSTANCES IN SOLUTION. C. R. Acad. Sci., Paris, 255, 2283-2284; Water Pollution Abstracts, Vol. 36, No. 5, Abst. No. 819. 1963.

The results are given of experiments on the behavior of fish (Danio malabaricus and goldfish) in the presence of various odorous substances, including specific substances in fish (carp) skin, and vanillin, coumarin, acetic acid, hydrochloric acid, nitrobenzene and iodine. For each substance the fish were repulsed by weak and strong concentrations and attracted by intermediate concentrations, but the concentrations corresponding to each reaction differed with different substances. The test fish were extremely sensitive to the presence of certain substances, such as coumarin.

6591. Ivasik, V. M. 1961. HYDROLOGICAL AND HYDROCHEMICAL CONDITIONS IN PONDS AND THEIR RELATION TO DISEASES OF CARP IN POND FISHERIES IN THE WESTERN DISTRICTS OF THE UKRAINIAN S.S.R. Probl. Fish., U.S. S.R., 17, 169-175; Biol. Abstr., 1962, 39, 1036; Water Pollution Abstracts, Vol. 36, No. 5, Abst. No. 821. 1963.

Prolonged exposure of carp to low water temperatures (0.1°-0.2° C) has been found to cause Staff's disease. Normal temperatures can be maintained in ponds in winter by temporarily interrupting the inflow of water and aerating the water in the pond. In summer, high temperatures combined with other factors such as increased concentrations of organic matter and ammonia make the fish susceptible to fungal diseases of the gills. Mass mortality of fish in some ponds in the Ukraine has been caused by the entry into the ponds of humic substances from swamps. In the western parts of the Ukraine the water is only slightly mineralized, and organic and mineral fertilizers and lime should be added.

6592. Foster, R. F., and D. McConnon. 1962. RELATIONSHIPS BETWEEN THE CONCENTRATION OF RADIONUCLIDES IN COLUMBIA RIVER

WATER AND FISH. U. S. Atom. Energ. Comm., HW-SA-2688, 24 pp.; Nuclear Sci. Abstr., 1962, 16, 3968; Water Pollution Abstracts, Vol. 36, No. 5, Abst. No. 823. 1963.

The uptake of radioactive isotopes by fish is affected by many different factors, resulting in wide variability, so that a large number of samples collected over a period of at least a year is necessary to determine the average concentration in the fish and fluctuations with time, at least in the case of radionuclides with relatively short half-lives. Concentration factors derived theoretically, assuming a high rate of intake by fish throughout the year, will overestimate considerably the amounts of radionuclides which will accumulate in the fish, where the nuclides have half-lives of several weeks or less and there are wide seasonal variations in ecological conditions.

6593. Moens, N. L. W. I., and R. Peelen. 1962. BIOLOGICAL PURIFICATION IN RIVER WATER UNDER THE INFLUENCE OF LIGHT. *Hydrobiologia*, 19, 339-350; Water Pollution Abstracts, Vol. 36, No. 6, Abst. No. 991. 1963.

In evaluating water quality, attention is usually paid to the concentration of dissolved oxygen and the 5-day B. O. D., but the authors point out that much of the dissolved oxygen in water comes, not from mechanical aeration by wind and waves, but by the photosynthetic action of plants, especially phytoplankton. In an attempt to confirm the role of phytoplankton in the self-purification of water, experiments have been carried out in which samples of Rhine water, after filtration through gauze to remove much of the zooplankton and larger detritus, were exposed continuously to light; control samples were kept in the dark. Some results of the preliminary experiments are shown graphically and discussed. The experiments showed that the amount of oxygen produced by phytoplankton exposed to light is considerable, and it is suggested that measuring the oxygen production of a polluted water by exposure to light might be used as a method for determining the capacity of a given water to receive sewage or industrial waste waters. Various dilutions of the waste water could be added to samples of water from the receiving stream to determine the concentration of the waste at which the phytoplankton are just able to produce the normal amount of oxygen; the results could probably be obtained in 3-5 days.

6594. Prokešová, V. 1962. INFLUENCE OF AERATION ON B. O. D. *J. Wat. Polluf. Contr. Fed.*, 34, 1268-1275; Water Pollution Abstracts, Vol. 36, No. 6, Abst. No. 992. 1963.

Aeration is known to be important in the purification of polluted water and sewage as a means of maintaining aerobic conditions, but little is known about the effect of aeration on purification when sufficient oxygen is already present without aeration. Experiments were, therefore, carried out to determine the effect of aeration on B. O. D.; to enable direct comparison to be made between aerated and unaerated samples, a special modifica-

tion of the B. O. D. test was developed. It was found that the aerated samples always had a lower B. O. D. than the unaerated samples and showed a lower rate of oxygen consumption, suggesting that aeration reduced the rate of substrate oxidation. The possible causes of the observed phenomena are discussed; the author suggests that the high values of the deoxygenation constant calculated for some natural streams, particularly shallow turbulent ones, from B. O. D. measurements in the laboratory, may be only apparent, and that the process of self-purification may actually result from rapid stabilization at a relatively low rate of oxygen consumption.

6595. Ophel, I. L., and J. M. Judd. 1962. ABSORPTION OF RADIOSTRONTIUM BY THE GILLS OF FRESH-WATER FISH. *Nature, Lond.*, 194, 1187-1188; Water Pollution Abstracts, Vol. 36, No. 6, Abst. No. 996. 1963.

In experiments to determine the site of direct absorption of radioactive strontium by fish, the accumulation of the isotope by goldfish (*Carassius auratus*) with only the head and gills exposed to a solution of strontium-90 was compared with that accumulated by goldfish with the whole body exposed. Each fish was placed in a tube, with its head resting on an open grid at the lower end, and suspended vertically in distilled water containing strontium-90; precautions were taken to prevent dessication of the partially-immersed fish, and the solution was aerated continuously. Various immersion periods and concentrations of isotope were used. The concentration of strontium-90 accumulated was determined by weighing each fish, wet-ashing it with concentrated nitric acid and hydrogen peroxide, evaporating the resulting solution and counting the residue. The results showed no significant difference between the concentrations of strontium-90 accumulated by the partially- and totally-immersed fish under the same experimental conditions.

6596. Lloyd, R., and D. W. M. Herbert. 1962. THE EFFECT OF THE ENVIRONMENT ON THE TOXICITY OF POISONS TO FISH. *J. Instn. publ. Hlth Engrs*, 61, 132-145; Water Pollution Abstracts, Vol. 36, No. 7, Abst. No. 1178. 1963.

Investigations into the effect of the chemical and physical properties of the environment on the toxicity of poisons to fish are reviewed. The safe concentration of a poison can be estimated from the log-survival time/long-concentration curve. The temperature and pH value of river water may have considerable influence on the toxicity of a poison which undergoes ionization. Changes in temperature, and concentrations of calcium and dissolved oxygen may alter the susceptibility of fish to a poison. The toxicity of a mixture of poisons may differ from that of the single poisons. The toxicity of ammonia and monohydric phenols to rainbow trout has been successfully predicted in laboratory tests. In discussion, the authors agreed that more information is required on the relative susceptibilities of different species of fish and other aquatic organisms. No

evidence has been found that suspended solids harm fish by clogging the gills.

6597. Warren, K. S. 1962. AMMONIA TOXICITY AND PH. *Nature*, Lond., 195, 47-49; *Water Pollution Abstracts*, Vol. 36, No. 7, Abst. No. 1179. 1963.

The author reviews research on the physico-chemical factors affecting ammonia toxicity to various organisms, including work on the effect of variations in pH value on the toxic effect of ammonia on fish. A list of 34 references is appended.

6598. Devlaminck, F. 1960. TOXICOLOGICAL STUDY OF FLOTATION AGENTS USED IN COAL PREPARATION IN BELGIUM. *Bull. Centre belge Ét. Document. Eaux*, No. 50, 286-293; *Water Pollution Abstracts*, Vol. 36, No. 7, Abst. No. 1183. 1963.

The author describes a study to determine the toxicity of various coal-flotation agents used in Belgium. The agents used are listed and the technique employed in the fish toxicity tests is outlined. The agents are classified, the symptoms of poisoning and the physiological effects are discussed, and the minimum lethal doses for hard water at 20° C are tabulated. Agents capable of giving up phenol to water have a dangerous long-term effect on the fish but discharge of effluents containing such products is easily controlled by determining the phenol index. The presence of pine oil or methyl isobutyl carbinol (which have anaesthetic properties) in the effluent results in spectacular but less harmful effects upon the fish. Results of investigations on effluents discharged from 2 coal-preparation plants, one using carbonol and the other using a commercial oil preparation as flotation agents, confirm the results of the laboratory tests.

6599. McCarren, E. F., J. W. Wark, and J. R. George. 1961. HYDROLOGIC PROCESSES DILUTING AND NEUTRALIZING ACID STREAMS OF THE SWATARA CREEK BASIN, PENNSYLVANIA. *U. S. Geol. Surv. prof. Pap.* 424-D, D. 64-D. 67; *Water Pollution Abstracts*, Vol. 36, No. 8, Abst. No. 1356. 1963.

A study of water quality in the Swatara Creek Basin, Pa., is reported, the chemical quality at various points on the different streams being shown diagrammatically on a map. The chief source of pollution is acid waste water which has accumulated in underground pools in the excavations of disused anthracite mines. The chemical composition of this water is tabulated for various mines. The study showed that the acid water in Swatara Creek was diluted and neutralized by water from Upper and Lower Little Swatara Creeks, which is unaffected by mine waste waters, contains calcium bicarbonate, and has a pH value of 6.0-7.0. The Swatara is not acidic when it flows into the Susquehanna River. If mining is recommenced, other tributaries, including Little Swatara Creek (containing calcium bicarbonate water) and Quittapahilla Creek (containing

calcium-magnesium-bicarbonate-sulphate water) would be capable of neutralizing the acid water. It is suggested that in other areas the effect of coal mine waste waters on streams might be overcome by diverting suitable nearby streams into the acid streams.

6600. Ophel, I. L. 1962. THE FATE OF RADIO-STRONTIUM IN A FRESH-WATER COMMUNITY. *Radioecology*, 17 pp.; *Nuclear Sci. Abstr.*, 1963, 17, 1008; *Water Pollution Abstracts*, Vol. 36, No. 10, Abst. No. 1702. 1963.

A study has been carried out over a period of 5 years on a small natural lake which receives water containing low concentrations of strontium-90 leached from a nearby waste disposal area. About 25 percent of the incoming strontium-90 is retained within the lake, and of this amount 90 percent is present in the bottom materials. The dense aquatic vegetation in a marginal zone, covering almost one-third of the lake area, contains less than 1 percent of the retained strontium-90. Fish in the lake gradually accumulated strontium-90, reaching an equilibrium after exposure for 4 years; such a true equilibrium is attained only when all the fish have spent their entire life in a contaminated environment, and the resulting concentration factor is much higher than would be predicted from the experimental exposure of fish to strontium-90 for short periods.

6601. Itazawa, Y. 1959. GAS CONTENT OF THE BLOOD IN RESPONSE TO THAT OF MEDIUM WATER IN FISH. II. COMPARISON OF THE RESPONSES IN SEVERAL SPECIES. *Bull. Jap. Soc. sci. Fish.*, 25, 301-306; *Water Pollution Abstracts*, Vol. 36, No. 10, Abst. No. 1708. 1963.

Using a method similar to that previously used in studying carp, investigations were carried out on the relation between the oxygen tension in the medium and the oxygen concentration in the blood of five species of fish, namely rainbow trout (Salmo irideus), Japanese eel (Anguilla japonica), "Suzuki" (Lateolabrax japonicus), striped mullet (Mugil cephalus), and brown-spotted grouper (Epinephelus fario). The results, which are given graphically, show that the relationship is similar to the oxygen dissociation curve of blood. The maximum concentrations of oxygen reached in the blood, which are tabulated, varied with the species of fish. For fresh-water fish the maximum level decreased in the order Salmo irideus > Cyprinus carpio > Anguilla japonica; and for brackish or sea-water species the order was Lateolabrax japonicus > Mugil cephalus > Epinephelus fario. These orders of concentration were positively correlated with the activity of the fish. The critical tension of oxygen in the medium required to maintain the maximum concentration of oxygen in the blood also varied with the species of fish, and appeared to be negatively related to the resistivity of the fish to lack of oxygen.

6602. Vinson, S. B., C. E. Boyd, and D. E. Ferguson. 1963. RESISTANCE TO DDT IN THE MOSQUITOFISH, GAMBUSIA AFFINIS. *Science*,

139, 217-218; Water Pollution Abstracts, Vol. 36, No. 10, Abst. No. 1711. 1963.

Results are given of experiments to compare the susceptibility to DDT of fish from localities with a past exposure to DDT and fish from previously untreated areas. It was found that mosquito-fish from waters near cotton fields that had had a long history of treatment with chlorinated hydrocarbon pesticides showed a marked resistance to DDT compared with fish from areas that had no past exposure to insecticides. The possibility of a genetically resistant population developing as a result of periodic applications of insecticide is discussed.

6603. Arlet, J. W. 1959. THE TOXICITY OF ANIONIC DETERGENTS TOWARDS THE ALEVINs OF COMMON TROUT. Bull. franc. Piscic., No. 195, 41-45; Water Pollution Abstracts, Vol. 36, No. 10, Abst. No. 1724. 1963.

Experiments are described in which trout eggs and alevins (newly-hatched, 3 weeks old, and 6 weeks old) were exposed in incubation baths through which water containing up to 10 ppm anionic detergents was passed. After 24 hours in these solutions all the eggs hatched normally. The effects on the alevins are shown in a table. None of the alevins could withstand exposure for 15 hours to water containing 5 ppm or more of the surface-active agent; the 6-week-old alevins were more sensitive than the younger ones. Primary sodium alkylsulphate was less toxic than secondary sodium alkylsulphate.

6604. Perea, C. P., E. I. Gonzalez, and D. L. Saenz. 1962. TREATMENT AND HANDLING OF RADIOACTIVE WASTES IN THE ANDÚJAR URANIUM MILL. Junta de Energía Nuclear, Madrid, JEN-108-DMa/1-15, 38 pp.; Nuclear Sci. Abstr., 1963, 17, 1795; Water Pollution Abstracts, Vol. 36, No. 12, Abst. No. 2098. 1963.

A description is given of the Andújar uranium mill in Spain and the treatment of the radioactive waste waters before their discharge to the Guadalquivir River. The waste waters are neutralized with lime to pH 8, the solids are dumped in a tailings pond, and the effluent receives further sedimentation in a pond before discharge. This treatment reduces the concentrations of uranium, radium and gross alpha and beta activities by 87, 90, 94, and 96 percent, respectively, and the final effluent has no marked effect on the radioactivity of the river water.

6605. Anonymous. 1962. 1962 REPORT OF THE INTERSTATE SANITATION COMMISSION OF NEW YORK--NEW JERSEY--CONNECTICUT ON THE WATER POLLUTION CONTROL ACTIVITIES AND THE INTERSTATE AIR POLLUTION PROGRAMME. 82 pp.; Water Pollution Abstracts, Vol. 36, No. 12, Abst. No. 2100. 1963.

The water pollution section of this report contains information on progress in the abatement of pollution, including details of the treatment works constructed and planned; legal activities; and

intensive investigations of the excessive pollution of the Arthur Kill waterway including the effects on fish, determination of the assimilative capacity of the waterway, and a report on the waste treatment requirements. The method used to determine the assimilative capacity will now be used to examine and determine treatment requirements for waste waters discharged to other tidal waterways. No apparent toxic effects were observed on fish life in the Arthur Kill or the Kill Van Kull when adequate dissolved oxygen was present, but sometimes water in the Kill Van Kull contains substances which increase the minimum level of dissolved oxygen required to sustain fish life; the rate of decrease in oxygen concentration was found to be very important. A "harbor taste" in the fish flesh was found to be caused by petroleum products, a similar taste being produced by less than 1 ppm kerosene. The assimilative capacity of the Arthur Kill is less than 190,000 lb of B.O.D. per day, and New York and New Jersey are each entitled to one-half. To meet requirements, domestic and industrial waste treatment plants must produce at least a 75 percent reduction in the B.O.D. at present discharged or provide full secondary treatment with an 80 percent reduction in B.O.D., whichever produces the lower B.O.D. in the effluent.

6606. Elvins, B. J. 1962. INVESTIGATION OF THE ANIMAL POPULATION IN POLLUTED STREAMS. J. Inst. Sew. Purif., Pt. 6, 569; Water Pollution Abstracts, Vol. 36, No. 12, Abst. No. 2107. 1963.

The author describes a year's experience in the use of a new method of studying pollution by quantitative estimation of the aquatic fauna at various points along the course of the stream. Sampling stations are selected so that physical factors such as the character of the stream bed, rate of flow, temperature and light intensity are as nearly the same as possible, and six numbered bricks are placed in the stream at each station in approximately the same position in relation to flow and the surroundings. After a fortnight, one brick is lifted, the escaping animals are captured and counted, and the brick replaced; after a second fortnight the next brick is lifted, and this is continued throughout the season. The numbers of each species are plotted against time, and the flattening of the curve gives the stable population at that station. Results of chemical analyses of the water at the different stations were compared with the numbers of Gammarus pulex, Asellus aquaticus and Esphemarella ignita, and it was found that Gammarus and Esphemarella were immediately affected by discharge of a mainly organic effluent, and that pollution caused sensitive species to be replaced by more tolerant species. The limitations of this method are indicated.

6607. Feldt, W. 1960. RADIOACTIVITY IN FISH IN THE ELBE IN THE VICINITY OF THE GEESTHACHT REACTOR. Z. LebensmittUntersuch., 111, 465-474; Chem. Zbl., 1961, 132, 9498; Water

Pollution Abstracts, Vol. 36, No. 12, Abst. No. 2116. 1963.

Beta and gamma activities determined in ashed samples of skin, flesh, intestines, and bones of bream taken from the Elbe above and below the nuclear reactor at Geesthacht gave values much below the danger limit.

6608. Nakatani, R. E. 1962. DISTRIBUTION AND RETENTION OF Sr^{90} - Y^{90} IN TROUT. U. S. Atomic Energy Comm. Res. and Develop. Rept. HW-72500; Biological Abstracts, Vol. 45, No. 1, Abst. No. 488. 1964.

After trout were fed a single dose of 15 μC Sr^{90} - Y^{90} , the concentration of the isotope in various tissues was followed as a function of post-administration times. All tissues showed a sharp increase in Sr^{90} - Y^{90} concentration within the initial 24-hour period, and with the exception of bone, declined rapidly thereafter. After 16 days bone had a concentration of 0.2 $\mu\text{C}/\text{g}$ which decreased to 0.5 $\mu\text{C}/\text{g}$ at 100 days. The % of administered dose retained by trout averaged 25% at 24 hours and then gradually decreased to about 4.4% at 100 days. (Auth.)

6609. Schiffman, R. H. (Biol. Lab., Hanford Labs., Richland, Washington). 1961. THE UPTAKE OF STRONTIUM FROM DIET AND WATER BY RAINBOW TROUT. U. S. Atomic Energy Comm. Res. and Develop. Rept. HW-72107; Biological Abstracts, Vol. 45, No. 1, Abst. No. 508. 1964.

The concentration ($\mu\text{C}/\text{g}$) of Sr^{90} - Y^{90} in trout approached about 1.5 times the concentration ($\mu\text{C}/\text{ml}$) in the surrounding water in three weeks. Approximately 21 percent of the isotope administered in gelatin capsules was retained after one day, but when the isotope was incorporated into natural food, the retention was only about 7%. It was inferred that under the conditions of the experiment, uptake from the environmental water was greater than uptake through the food chain. (Auth.)

6610. Schiffman, R. H. (Biol. Lab., Hanford Labs., Richland, Washington). 1961. MOVEMENT OF STRONTIUM ACROSS THE GILL OF TROUT. U. S. Atomic Energy Comm. Res. and Develop. Rept. HW-72500; Biological Abstracts, Vol. 54, No. 1, Abst. No. 509. 1964.

A perfusion technique was used to determine the effect of calcium, phosphate, and pH on the influx rate of strontium across trout gills. The strontium influx was not affected by varying the calcium concentration in the external medium. Phosphate on either side of the gill caused an increased influx rate that was decreased by 2, 4-dinitrophenol thus suggesting strontium is actively transported. As pH increased, the strontium influx rate decreased. (Auth.)

6611. Rosenthal, Harold L. (Washington Univ. Sch. Dent., St. Louis, Missouri). 1963. UPTAKE, TURNOVER, AND TRANSPORT OF BONE SEEKING

ELEMENTS IN FISHES. Ann. New York Acad. Sci. 109(1): 278-293; Biological Abstracts, Vol. 45, No. 1, Abst. No. 953. 1964.

The rate of uptake of Ca^{45} , Sr^{90} , and S^{34}O_4 from the water in which they swim is linear with time for the male guppy (*Lebistes*). Similar results were obtained for the uptake of Ca^{45} , Sr^{90} by white cloud mountain fish (*Tanichthys*) and zebra fish (*Danio*) of mixed sexes. The rate of incorporation of the nuclides is also linear with time for various tissues of the body, such as muscle, viscera, head, and spine, but the distribution of the nuclides varies with the nature of the tissue and the element involved. The rate of uptake is also a function of the concentration of the nuclide in the water at constant ionic concentration and is adequately described by a logarithmic function of the form $Y = aX^b$, where Y is the concentration of the nuclide incorporated into the body and X the concentration present in the water and a and b are the constants. The slope of the equation (b) is the same within experimental error for all nuclides and species of fish tested. The Y-intercept (a) is similar for Ca^{45} and Sr^{90} but is significantly lower for S^{34}O_4 . In *Lebistes*, the rate of turnover of S^{34}O_4 , Ca^{45} , Sr^{90} is most rapid in soft, visceral tissue and is slowest for the spine. Muscle tissue exchanges the nuclides at intermediate rates. The biological half-life of the nuclides in the spine is estimated to be at least 2 years. A series of double tracer experiments, using Ca^{45} and Sr^{90} , indicates that fresh-water fishes have little ability to discriminate between Sr and Ca when the isotopes are taken up from the water in which they swim. (Auth.)

6612. Conte, Frank P., Harry H. Wagner, and Thomas O. Harris (Oregon State Game Comm., Corvallis). 1963. MEASUREMENT OF BLOOD VOLUME IN THE FISH *SALMO GAIRDNERI GAIRDNERI*. Amer. Jour. Physiol. 205(3): 533-540; Biological Abstracts, Vol. 45, No. 1, Abst. No. 1233. 1964.

The volume of blood in the steelhead trout (*Salmo gairdneri gairdneri*) was determined by the simultaneous use of radioactively labeled human serum albumin (HSA- I^{131}), Evans blue dye (T-1824), and radioactively labeled red blood cells (RBC- Cr^{51}). Blood volume derived from the plasma-hematocrit method utilizing Evans blue dye = 3.5 ± 0.9 ; for labeled albumin = 3.3 ± 0.9 ; through simultaneous use of both dye and labeled albumin = 2.9 ± 0.9 . Blood volume obtained directly through the sum of the plasma and packed red cell volumes as measured with either Evans blue dye or labeled albumin and tagged red blood cells = 2.8 ± 1.0 . Values are expressed as percent of body weight and are in agreement with those that have been reported in the literature for bony fishes (*Osteichthyes*). (Authors)

6613. Fujihara, M. P., and P. A. Olson. 1961. STUDIES ON THE FISH DISEASE *CHONDROCOCCUS COLUMNARIS*. U. S. Atomic Energy Comm. Res. and Develop. Rept. HW-69500: 160-165; Biological Abstracts, Vol. 45, No. 1, Abst. No. 2945. 1964.

Young salmon and rainbow trout showed increased resistance to columnaris as size and age progressed. Increased size also was related to a longer lag period between exposure and death. Temperature effects on survival differed between organisms suspended in sterile river water and in sterile river mud. (Authors)

6614. Conroy, D. A. (Univ. Nac. Buenos Aires, Buenos Aires, Argentina). 1963. STUDIES ON THE APPLICATION OF KANAMYCIN TO THE CONTROL AND TREATMENT OF SOME BACTERIAL DISEASES OF FISH. Jour. Appl. Bacteriol. 26(2): 182-192; Biological Abstracts, Vol. 45, No. 1, Abst. No. 2974. 1964.

A study was made of the pathogenicity of *Aeromonas liquefaciens*, *A. hydrophila*, *A. punctata*, *Pseudomonas putida*, and *P. fluorescens* to freshwater fish; and a description of the symptoms produced by each of these organisms is given. It was shown that kanamycin is an effective therapeutic agent in the control and treatment of bacterial fish diseases. (Auth.)

6615. Tallqvist, Johanna. 1962. OCCURRENCE OF PLEROCERCIDS OF THE FISH TAPEWORM (*DIPHYLLOBOOTHRIUM LATUM*) IN PERCH AND RUFF FROM LAKE IIVESI AND LAKE NIINIVESI (SE FINLAND). Acta. Soc. Fauna Flora Fenn. 77(2): 1-10; Biological Abstracts, Vol. 45, No. 1, Abst. No. 3851. 1964.

Thirty-six percent of the perch examined were infected with plerocercoids of *D. latum*. The size of the plerocercoids indicates a continuous infection of perch. The degree of infection and the number of plerocercoids per fish increase with increasing age of the fish. Only 1.3% of the ruff investigated were infected. The causes of the difference in degree of infection in perch and ruff are discussed. (Auth.)

6616. Crossman, E. J. (Royal Ontario Mus., 100 Queen's Park, Toronto, Ont., Canada). 1962. THE GRASS PICKEREL *ESOX AMERICANUS VERMICULATUS* LeSUEUR IN CANADA. Roy. Ontario Mus. Life Sci. Div., Contr. 55. 1-29; Biological Abstracts, Vol. 45, No. 1, Abst. No. 4084. 1964.

Previous records of this form in Canada are reviewed. The present paper is based principally on 543 specimens collected in Jones Creek, Leeds County, Ontario, in the summer of 1960, and is intended to document something of the biology of this fish in Canada. Comparisons of body shape and pattern for the different sizes and ages are made. Distributional data are tabulated, and mapped. Habitat, sex ratio, spawning, egg production, food, age and growth, and parasites are discussed, with various tables and charts. (A. K. W.)

6617. Rosen, Donn Eric (Amer. Mus. Nat. Hist., New York, N. Y.). 1962. COMMENTS ON THE RELATIONSHIPS OF THE NORTH AMERICAN CAVEFISHES OF THE FAMILY AMBLYOPSIDAE. Amer. Mus. Novitates 2109. 1-35; Biological

Abstracts, Vol. 45, No. 1, Abst. No. 4093. 1964.

The order Cyprinodontiformes (= Microcyprini, Cyprinodontes, Cyprinodontida) has been divided into 2 major groups, the Cyprinodontoidae (typical killifishes) and the Amblyopsidae (North American cavefishes) for the past half century. Evidence is now presented indicating that these 2 groups of fishes have been improperly associated taxonomically. On the basis of numerous osteological, myological, and functional features, the amblyopsids are shown to resemble *Aphredoderus* in considerable detail. Features that appear to unite the amblyopsids and *Aphredoderus* are found also in *Percopsis*. Many, though by no means all, of the characters common to amblyopsids and percopsiforms are identified in 3 gadids, a brotulid, and an ophidiid. The provisional assignment of the Amblyopsidae to a separate order, the Amblyopsiformes, is proposed, adjoining the Percopsiformes in current classification. The resemblances between these 2 orders and the Gadiformes and Ophidioidae suggest the existence of a phyletic assemblage in which each group represents a different level of structural organization. The Amblyopsiformes, Percopsiformes, Gadiformes, and Ophidioidae all include forms characteristically inhabiting dim or lightless environments. (Auth.)

6618. Balon, Eugeniusz K., and František Havlena (Laboratorium für Ichthyologie, Železná Studienka 806, Bratislava (ČSSR)). 1964. STUDIEN UBER DIE ICHTHYOFAUNA DES TSCHESCHOSLOWAKISCHEN DONAU-ABSCHNITTES. Archiv für Hydrobiologie, Supplement-Band XXVII, Band I, Heft 3, pp. 325-364.

The work presents a review of the results that have been achieved in studying the ichthyofauna of the Czechoslovak-Danube section, referring to intensive research work carried out by the Laboratory of Ichthyology in Bratislava through eight years.

The paper contains a short description of currently applied methods (Chapter II), developmental studies and their results (Chapter IV), age and growth, distribution of species, biometrics, taxonomy, morphology, fertility, parasitological invasion and quantity as well as standing crops and population dynamics.

For the first time, faunistic and ecological characterization (Chapter III) takes into consideration the distribution of fish in the crossprofile of the river as well, whereby the main biotops are determined as follows: (1) The river; (2) the inundation territory; (3) the exterior dike territory, including its various fish quantities and its species. The precise characterization of ecological fish-groups based on S. G. Kryzanovskij's conception leads to the conclusion that it is the inundation territory which offers the most important biotope for the normal life of Danube fish populations.

From among 54 kinds of fish living in the Czechoslovak-Danube section, 52 species live in the main stream, 45 in the waters of the inundation-territory and 28 in the lateral levee reservoirs. Up to now, the least investigated part of the river is its main stream where continued research work

keeps leading to new findings.

Conclusions are made regarding further studies (Chapter V) and concerning the protection of the Danube biocoenoses as well as their economical exploitation (Chapter VI). (Auth.) (Summary in English; text in German)

6619. Williams, H. Harford (Commonwealth Bur. of Helminthology, St. Albans, Herts., England). 1964. SOME OBSERVATIONS ON THE MASS MORTALITY OF THE FRESH-WATER FISH RUTILUS RUTILUS (L.). Parasitology, Vol. 54, No. 1, pp. 155-171.

From 24 May to 4 July 1961 about 12,000 roach, Rutilus rutilus (L.), died in a lake at Brynmill Park, Swansea, South Wales. Trichodina, Gyrodactylus, and Argulus were eliminated as the primary cause of death in the fishes examined as experiments carried out produced symptoms identical with those observed in the naturally diseased fish but these three parasites could not be found on the experimentally diseased fish. In view of the numbers of Thelohanellus present in the naturally diseased fishes and the well-known fact that myxosporidia of this genus cause various histopathological changes in their hosts, this genus may have been mainly responsible for the death of the roach investigated; this was probably augmented by secondary infections of the affected tissues with bacteria and fungi. Overcrowding, lack of water movement in the lake, and low oxygen concentrations may have been contributory factors.

Much more detailed work over a longer period should prove interesting if further similar epizootics occur, bearing in mind that fish parasites often increase in abundance with the age of the host and that this is also accompanied by a corresponding change in the parasite fauna. It is known that some fresh-water fishes may become infected with Ichthyophthirius almost immediately after hatching, with Trichodina during the first 6 days after hatching; Costia and Chilodonella may appear from the 9th day onwards, Dactylogyrus anchoratus from the 11th to 12th day, D. vastator from the 14th to 15th day, Neascus cuticola and Gyrodactylus from the 23rd day and Sanguinicola from the 30th to 32nd day.

6620. Alperin, Irwin M., and Richard H. Schaefer (New York State Cons. Dept., Albany, New York). 1964. JUVENILE BONEFISH (ALBULA VULPES) IN GREAT SOUTH BAY, NEW YORK. New York Fish and Game Journal, Vol. 11, No. 1, pp. 1-12.

During August and September (1962), 108 juvenile bonefish ranging from 33 to 81 millimeters in fork length were seined at Mercer's Island in Great South Bay (N. Y.). While they were present, the juveniles exhibited rapid growth equal to a modal increase of 25 millimeters with no overlapping sizes during the two months. It is assumed that these bonefish were present at this northerly extreme of their range through larval drift and inshore migration of metamorphosing leptocephali into an environment suitable for transformation.

6621. Poole, John C. (New York State Cons. Dept., Albany, New York). 1964. FEEDING HABITS OF THE SUMMER FLOUNDER IN GREAT SOUTH BAY. New York Fish and Game Journal, Vol. 11, No. 1, pp. 28-34.

Stomachs from 1,210 summer flounder collected in Great South Bay in the summers of 1958 and 1959 were examined. These fish had fed on a wide variety of organisms, but mainly upon sand shrimp and winter flounder. Analysis of the data indicated that feeding activity remains constant throughout the summer. Therefore, the major seasonal fluctuations of the sport fishery for summer flounder cannot be attributed to seasonal changes in feeding activity. (Auth.)

6622. Smith, Ralph H. (New York State Cons. Dept., Albany, New York). 1964. EXPERIMENTAL CONTROL OF PURPLE LOOSESTRIFE (LYTHRUM SALICARIA). New York Fish and Game Journal, Vol. 11, No. 1, pp. 35-46.

Trial plots of purple loosestrife were treated with various herbicides. Control, but not eradication, was best obtained by foliar applications of water solutions or oil and water emulsions of the so-called low-volatility esters of 2, 4, 5-T or 2, 4-D and 2, 4, 5-T in mixture, or silvex, at a concentration of 8 pounds acid equivalent per acre when at least 200 gallons of total solution were applied per acre. Satisfactory control did not result from treatment with various amine salts of 2, 4-D; the isooctyl ester of 2, 4-D, a formulation of 2, 3, 6-TBA, amitrole, or ammonium sulfamate. (Auth.)

6623. Booke, Henry E. (New York State Cons. Dept., Albany, New York). 1964. A REVIEW OF VARIATIONS FOUND IN FISH SERUM PROTEINS. New York Fish and Game Journal, Vol. 11, No. 1, pp. 47-57.

Use of the species-specificity of electrophoretic patterns of serum proteins in understanding phylogenetic relationships requires a knowledge of the manner in which these proteins may vary. The major studies that have been made of the conditions that cause serum proteins to vary in fishes are reviewed. Possible applications of such information in fish management and pollution research are suggested. (Auth.)

6624. Horká, Jaroslava (Dept. of Hydrobiology, Charles Univ., Prague, Czechoslovakia). 1963. TO THE STATISTICAL EVALUATION OF THE POND BOTTOM FAUNA SAMPLING ACCURACY. (K STATISTICKÉMU ZHODNOCENÍ PŘESNOSTI ODBĚRU KVANTITATIVNÍCH VZORKŮ ZOOBENTHOSU RYBNÍKA.) Věstník Československé Společnosti Zoologické (Acta Societatis Zoologicae Bohemoslovenicae), Vol. 27, No. 4, pp. 280-294.

In the carp pond Velký Pálenec near Blatná, southwest Bohemia, quantitative bottom samples in 6 various types of the bottom and during various seasons were taken in six-sample series. The main aim of the work was to evaluate the sampling accuracy according to the inequal distribution of bottom

fauna. Supposing that organisms more abundant than 20 individuals per sample are spread normally, a relative error of the mean estimation of the number and weight and nitrogen biomasses of the bottom dwellers in % were calculated by the relation

$$a = \frac{2.57 \cdot 100s}{\bar{x} \cdot \sqrt{n}}$$

The error was reckoned for individual groups of organisms as well as for whole samples. The number of samples which ought to be taken to reach 90% accuracy is calculated by the relation

$$n = \left(\frac{1.97 \cdot 100s}{10\bar{x}} \right)^2$$

By taking 2 samples from one sampling station the relative error of the mean estimation of the number of organisms and their weight in no case reached a smaller value than 10%. The most frequent limits of the error were 20 and 80% both for the number and weight of organisms. In most cases the error of the number estimation decreased by estimating the weight. By estimating the nitrogen contents no further decreasing of the error was effected. The size of the error depended first of all on the bottom type and on the season. In the series from sandy bottom types the error reached greater value than from muddy ones. When the number of samples taken from one station was increased to 3, the error decreased, compared with 2 samples by a fifth, with 6 samples to a half. (Auth.)

6625. Dees, Lola T. (Br. of Reports, Bur. Comm. Fish., U. S. Fish & Wildl. Serv., Washington, D. C.). 1963. INDEX OF FISHERY BIOLOGICAL PAPERS BY U. S. FISH AND WILDLIFE SERVICE AUTHORS APPEARING IN NONGOVERNMENT PUBLICATIONS 1940-56. U. S. Fish and Wildlife Circular 151, 138 pp.

This index contains an author and title index and a subject index of the titles.

It includes only those papers and books, technical and popular, which concern the biology of fishes and shellfishes. Some of these papers were written jointly by Fish and Wildlife Service biologists and others. Furthermore, not all of these listings are official publications of the Fish and Wildlife Service, but were written for private enterprise by biologists during their employment by the Service.

6626. Sinclair, Ralph M. (Tennessee Dept. Public Health, Nashville). 1964. WATER QUALITY REQUIREMENTS FOR ELMID BEETLES. Tenn. Stream Pollution Control Bd., Dept. Public Hlth., 14 pp.

The riffle beetle family (Elmidae, Coleoptera) has generally been considered a "clean-water" group in the benthic community. Recent studies in Tennessee have shown that several species are tolerant of a wide variety of effluents, and may be found even in poorly aerated sections of polluted streams. Illustrated flow chart identification keys are included for both larvae and adults of the eastern genera. The response of many species to different

pollutants is given. The lower Tennessee and Cumberland Rivers apparently do not have an Elmid fauna. Stenelmis sexlineata is most indifferent to a wide spectrum of effluents and environmental conditions. (Auth.)

6627. Thomson, J. M. (Div. of Fish. & Oceanog., Commonwealth Scientific and Industrial Res. Org., Cronulla, Sydney, Australia). 1963. SYNOPSIS OF BIOLOGICAL DATA ON THE GREY MULLET MUGIL CEPHALUS LINNAEUS 1758. CSIRO Fish. & Oceanog., Fisheries Synopsis No. 1, 67 pp.

This synopsis of the biology of the striped (grey) mullet was prepared originally for use in the assessment of the status of the Australian stocks. Information contained in the synopsis, however, is world-wide in scope and was derived from an extensive list of references. Major topics include identify, distribution, biometrics and life history, population, exploitation, population and management, and pond fish culture.

6628. Anonymous. 1963. REPORT OF THE FAO WORKING PARTY FOR RATIONAL UTILIZATION OF TUNA RESOURCES IN THE ATLANTIC OCEAN. FIRST SESSION, FAO, ROME: 25-30 OCTOBER, 1963. FAO Fisheries Reports No. 13, 23 pp.

This report explains the background, objectives and organization, results achieved, conclusions, and recommendations of the first session of the FAO Working Party for the Rational Utilization of Tuna Resources in the Atlantic Ocean. Included are lists of officers, participants, and working and information papers that were presented.

6629. McMahon, John W. (Atomic Energy of Canada Ltd., Environmental Res. Br., Chalk River, Ontario, Canada). 1963. MONOGENETIC TREMATODES FROM SOME CHESAPEAKE BAY FISHES. PART I: THE SUPERFAMILIES CAPSALOIDEA PRICE, 1936 AND DICLIDOPHOROIDEA PRICE, 1936. Chesapeake Science, Vol. 4, No. 4, pp. 151-160.

The identification of monogeneid parasites and their hosts has received little attention in the area of the Middle Atlantic Bight.

This paper consists of discussions and descriptions of nine species of Monogenea of the genera Monocotyle Taschenberg 1878; Empruthotrema Johnston and Tiegs 1922; Loimopapillosum Hargis 1956b; Benedenia Diesing 1858; Tagia Sproston 1946; Bicotylophorinae Yamaguti 1963; Clupeocotyle Hargis 1955c; and Mazocraeoides Price 1936. Three species (Bicotylophora trachinoti, Clupeocotyle brevoortia, Mazocraeoides georgei) are completely redescribed and they and the remaining six are reported from the Chesapeake Bay area for the first time. (Auth.)

6630. Massmann, William H. (5907 Gloucester Ave., Springfield, Virginia). 1963. SUMMER FOOD OF JUVENILE AMERICAN SHAD IN VIRGINIA WATERS. Chesapeake Science, Vol. 4, No. 4, pp. 167-171.

This study was made to determine the feeding

habits of juvenile shad during late summer in the Pamunkey and Mattaponi Rivers and to discover, if possible, reasons for an apparent upriver migration. The stomachs of 1949 shad captured in 1953, 1954, and 1955 were examined. Insects were the most important food item; those of terrestrial origin made up a larger volume of food than did aquatic insects. Shad captured upriver from major spawning areas contained more food than those taken in the vicinity of spawning grounds.

Insects of terrestrial origin made up a larger proportion of food of shad from upriver, while aquatic insects made up a larger proportion of food from downriver. The feeding of young shad in the Pamunkey River differed in both quantity and quality from those in the nearby Mattaponi River. Feeding began to increase in late afternoon, was most active at dusk, continued to a lesser extent during night, and almost ceased by midday. (Auth.)

6631. Frisbie, Charles M., and Douglas E. Ritchie, Jr. (Chesapeake Biol. Lab., Solomons, Maryland). 1963. SPORT FISHING SURVEY OF THE LOWER POTOMAC ESTUARY, 1959-1961. Chesapeake Science, Vol. 4, No. 4, pp. 175-191.

A survey of the sport fishery was conducted in a 265 square mile area of the lower Potomac Estuary during the summer and fall of 1959, 1960, and 1961. Fisherman interviews, postal card questionnaires, and aerial boat counts were used to determine angling pressure, rates of catch, estimated harvest, species importance, and economic value of the sport fishery.

Postal responses were increased from 33.5 to 66.3 percent, perhaps minimizing bias from non-response. No important differences were found in 1961 between initial and follow-up postal returns.

The 1961 estimate indicated that 101,000 angler trips produced approximately 1,200,000 fish weighing almost 642,000 pounds. Party size averaged 3.0 anglers who fished approximately 4.5 hours per trip and creeled 2.6 fish per man-hour.

Virtually no significant differences were found between rates of catch for incomplete and complete trip data in the only year tested--1961. Interview or postal surveys appear equally effective in providing rates of catch and each might be used solely in future surveys. Confidence limits for 1961 revealed narrow ranges for both incomplete and complete trip estimates of fishing pressure and harvest, indicating precise survey methods.

Trolling was the more productive fishing method for striped bass and bluefish. Still fishing yielded higher catches of spot, white perch, weakfish, yellow perch, and other bottom species. Resident striped bass ranked first in importance to the sport fishery in 1960, primarily due to recruitment of the dominant year-class of 1958. Throughout the survey, fish of age group II dominated the striped bass catch, while striped bass six years and older made up less than six percent. The spot ranked first in the 1961 catch.

During the five-month survey in 1961, an estimated \$594,000 was spent by Potomac Estuary

anglers. The average angler spent \$5.80 on each of his 29 mean yearly trips. (Authors)

6632. Nelp, Wil B., Henry N. Wagner, Jr., and Frank J. Schwartz (Chesapeake Biol. Lab., Solomons, Maryland). 1963. TOTAL BODY RADIOACTIVITY AND THE LACK OF EXCRETION OF CO-60 VITAMIN B₁₂ BY THE AGLOMERULAR OYSTER TOADFISH OPSANUS TAU. Chesapeake Science, Vol. 4, No. 4, pp. 192-194.

Evidence is presented that vitamin B₁₂ was not secreted by the renal tubule of the aglomerular oyster toadfish. A lack of secretion was demonstrated by measuring the total body radioactivity of fish for 38 days following the injection of Co-60 vitamin B₁₂. Details of the methods used, which could be applied to the study of other radioactive materials, are presented with observations on the body distribution of injected vitamin B₁₂ in the oyster toadfish. (Authors)

6633. Al-Saadi, Abdul Amir Majeed (Ph. D. Thesis, Univ. of Michigan, Ann Arbor). 1963. THE MICRO AND GROSS OSTEOLOGY OF THE LARGEMOUTH BASS, MICROPTERUS SALMOIDES (LACÉPÈDE), WITH SPECIAL REFERENCE TO THE NON-CELLULAR BONE. Dissertation Abstracts, Vol. 24, No. 2, p. 899.

This study was subdivided into three sections: (1) the osteogenesis of the non-cellular bone of the largemouth bass; (2) the histological structure and some aspects of the physiology of the non-cellular bone; and (3) the gross morphology of the skeleton of the largemouth bass.

To study osteogenesis in the largemouth bass, sac fry and advanced fry of 12 to 15 mm, and young of 20 mm - 7 cm were used. Materials were fixed, embedded, sectioned and stained. Stains included Mallory's, Masson's, silver, picro-fuchsin, hematoxylin-eosin and P. A. S.

Four types of bone formation were found in the largemouth bass. (1) Achondral--where the bone is formed in the complete absence of cartilage either in connective tissue or mesenchyme. Most of the membrane bones are formed in this manner. (2) Parachondral--where the bone is formed in the neighborhood of cartilage. The growing bone takes the same outline as the cartilage. This bone may grow toward the cartilage to provoke endochondral ossification. Small bony trabeculae may also grow into the cartilage to destroy the latter and bring undifferentiated elements into the area to initiate endochondral ossification. This type of bone formation is found in the bones of the otic, orbital, and olfactory capsules. (3) Perichondral--this kind of bone formation takes place in most cartilage bone. It begins when the perichondrium stops forming cartilage and becomes periosteum. The periosteum begins to make a ring of bone around the cartilage. This ring of bone grows by apposition. From this ring in some instances, bony trabeculae grow into the cartilage to provoke endochondral ossification. (4) Endochondral--this type of ossification is not as common as the first three. However, it occurs in the branchial arch bones, the vertebrae, and some

other bones. Blood vessels as well as bony growths from parachondral or perichondral bones provoke this type of ossification. Sometimes the cartilage becomes hypertrophied prior to its removal. Some bony spicules are formed in the space left behind by the removal of cartilage. Most of the space becomes marrow cavity.

The early formed bone as well as bone in old adults lack osteocytes completely.

For histological study, bones were used from fishes ranging between 15 mm to 29 cm, in addition to the preparations made for the study of osteogenesis. Specimens were fixed, embedded, sectioned, and stained. Furthermore, ground sections were made from dry bones. In addition, bones from alizarin red-S injected fish were used. Ground- and micro-sections were made from these bones to determine the areas of high activities, such as growth, resorption, and remodeling.

The bone of the largemouth bass is completely non-cellular, primary, lamellated, and vascular. Both compact bone and cancellous bones are found. Bone growth is mainly by apposition; however, in the "long bones" of the branchial arch epiphyseal growth occurs. In the epiphyseal cartilage mass, which is located at one end of the bone, four zones are distinguishable: (a) zone of undifferentiated cartilage, (b) zone of proliferating cartilage, (c) zone of flattened cartilage, and (d) zone of hypertrophied cartilage. The epiphyseal cartilage keeps the bone growing in length.

Resorption and remodeling processes are prominent in the tooth-bearing bones. No osteoclasts were found. The bone is exclusively primary and, therefore, no primary or secondary osteons are present.

The study of gross morphology was based on whole, dry skeletons, on cleared and stained specimens and on dissections. Different sizes (ages) of fishes were used. The skeleton was divided into functional regions and the bones of each region were described. Bones were also classified as to membrane or chondral origin. Disclosed are the morphology and relationships of each bone, and change of shape, size, and location with age. A basis is achieved for osteological comparison of the largemouth bass with other fishes. (Auth. Abst.)

6634. Hall, James Dane (Ph. D. Thesis, Univ. of Michigan, Ann Arbor). 1963. AN ECOLOGICAL STUDY OF THE CHESTNUT LAMPREY, *ICHTHYOMYZON CASTANEUS* GIRARD, IN THE MANISTEE RIVER, MICHIGAN. Dissertation Abstracts, Vol. 24, No. 2, pp. 901-902.

The purpose of this study is to supply quantitative life history data for an unusually abundant population of the parasitic chestnut lamprey and to estimate the magnitude of its predation upon the associated rainbow and brook trouts. Research involved primarily the adult phase of lamprey in the upper Manistee River of Michigan. The population in the river was studied by direct observation with skin-diving equipment and by capturing feeding adults in baited traps in a mark-and-recapture program

extending from October 1960 to March 1962. Feeding of the adult lamprey and its effect on host fishes were studied in aquariums periodically from July 1959 to January 1962.

The population study was most intensive in a one-mile stretch of the river (marking area), but traps were also set as far as 18 miles upstream and 24 miles downstream from the marking area. Between May and November 1961, 1,911 adult lampreys were marked individually. Of 11,066 captures made in this interval, 2,785 were recaptures of marked lampreys (many individuals were recaptured more than once).

In the Manistee River the adult lamprey lived about 18 months in the parasitic phase, but fed actively for only about 5 months near the middle of its adult life span (May through October). During the peak of the feeding season, in June and July 1961, about 30 percent of the trout (7 inches and longer) had lampreys attached. Almost all lamprey predation in the Manistee River was directed at the trouts.

Many of the lampreys used in aquarium experiments died from furunculosis (the first record of a bacterial disease from any species of lamprey). Limited data from remaining lampreys suggested that the destructive potential (grams of fish killed per gram of growth) of the chestnut lamprey was directly related to the size of the lamprey and was similar to that of the sea lamprey of comparable size. For the size range of adults of the chestnut lamprey in the Manistee River, the estimated fish-kill averaged about 20 grams per gram of growth by the lamprey.

In May 1961 there were approximately 2,000 adult lampreys in the marking area. The mortality rate of these lampreys was high; only 200 were present by October 1961. During this interval the average length of the lampreys increased from about 105 mm to 175 mm (average weights 1.8 and 9.1 grams, respectively).

From the product of instantaneous growth rate and average biomass during each trapping period of about 12 days, net production of the chestnut lamprey population in the marking area from May through October 1961 was calculated to be 4.44 kg (1.32 pounds/acre). Production was negligible during the rest of the year.

The trout mortality caused by lamprey predation in the one-mile marking stretch of the Manistee River, estimated from the product of destructive potential and net production for each period, could have been as much as 70 kg (21 pounds/acre), about one-third of the trout available to anglers during the 1961 trout season.

Net production of the lamprey population was much lower per unit area than any previous measurement of production of a single fish species, but none of these species was at as high a trophic level. Total lamprey production in 1961 was about 1.3 times the weight of the standing crop in May. Because the growth rate did not keep pace with the very high rate of mortality of the adult lampreys, there was a steady decrease in the standing crop to about one-half

of its initial value by the end of the season. There were indications that the mortality rate for adults of the chestnut lamprey in the Manistee River is substantially greater than that for larvae of the species. (Auth. Abst.)

6635. Linton, Joe Robert (Ph. D. Thesis, Univ. of Missouri, Columbia). 1963. THE EFFECT OF THYROXINE ON ACETYLCHOLINESTERASE AND SODIUM FLUX IN THE CHANNEL CATFISH. Dissertation Abstracts, Vol. 24, No. 2, p. 903.

Several recent studies have implicated the enzyme acetylcholinesterase as being involved in the metabolism of sodium ions in a variety of tissues. Koch (1954) found the enzyme to be associated with Na transport in the gill of the crab, *Eriocheir sinensis*. Fleming et al. (in press) showed a relationship between the amount of gill cholinesterase and the degree of euryhalinity in a group of cyprinodontid fishes.

There has also been considerable interest in the possible role of thyroxine in the osmoregulation of teleosts. It is the purpose of this study to determine the effect of thyroxine on sodium fluxes and acetylcholinesterase activity in the gill of the channel catfish, *Ictalurus punctatus*. In order to determine the role of this enzyme in sodium metabolism, acetylcholinesterase inhibitor, eserine, was studied in relation to Na fluxes.

Gill acetylcholinesterase activity was determined titrimetrically after the method of Jensen-Holm et al. (1953). The substrate used was acetylcholine iodide, the temperature, 37° C, the pH, 7.5. The optimum substrate concentration was found to be 0.004M.

It was found that thyroxine significantly increased acetylcholinesterase activity and that this increase could be diminished by treatment with thiourea.

It was further established that thyroxine treatment significantly decreased sodium outflux from fish held for one week or more in deionized water. This Na retaining effect of thyroxine was diminished with both eserine and thiourea treatment, indicating that the effect may be due to the stimulation of the enzyme by thyroxine.

Using the conversion ratio of serum I^{131} to protein-bound I^{131} to determine thyroid activity, it was found that thyroid activity, as well as enzyme activity, increased as the salinity of the medium increased.

These observations indicate that the thyroid gland may play a negative part in osmoregulation through its effect on the gill cholinesterase, in the case of the channel catfish. (Auth. Abst.)

6636. Krumholz, Louis A. (Dept. of Biol., Univ. of Louisville, Louisville, Kentucky), and W. L. Minckley. 1964. CHANGES IN THE FISH POPULATION IN THE UPPER OHIO RIVER FOLLOWING TEMPORARY POLLUTION ABATEMENT. Transactions of the American Fisheries Society, Vol. 93, No. 1, pp. 1-5.

The abatement of pollution in the upper Ohio

River following closure of the steel industries on July 15, 1959, led to a marked improvement in water quality accompanied by a rapid increase in the variety and abundance of fishes. Collections of fishes with rotenone from the auxiliary lock chamber at Montgomery Lock and Dam yielded more than twice as many different kinds and more than five times as many individuals within 11 days after the beginning of the steel strike than comparable samples taken from the same area before the strike. The principal difference in species composition was the occurrence of "clear-water fishes" that invaded the previously polluted area, probably from nearby unpolluted waters. (Authors)

6637. Summerfelt, Robert C. (Dept. of Zool., Southern Illinois Univ., Carbondale, Illinois). 1964. A NEW MICROSPORIDIAN PARASITE FROM THE GOLDEN SHINER, *NOTEMIGONUS CRYSOLEUCAS*. Transactions of the American Fisheries Society, Vol. 93, No. 1, pp. 6-10.

A new species of microsporidian (sporozoan) parasite from the ovaries of the golden shiner (*Notemigonus crysoleucas*) from southern Illinois is described. The name *Plistophora ovariae* n. sp. is suggested. Fresh spores are ovoid or ellipsoid and measure 8.42 ± 0.17 by 4.24 ± 0.15 microns for spore length and width, respectively. The primary site of infection is in the ovary, but the parasite is occasionally found in the liver and kidney of female fish. The parasite is not found in either the testis, kidney, or liver of male fish. The importance of this parasite to the bait industry is suggested, as it reduces fecundity and is suspected of causing sterility in older female brood fish. The parasite is of wide distribution, occurring in commercial bait hatcheries in Missouri, Arkansas, and Kentucky, as well as in Illinois. (Auth.)

6638. Watson, John E. (U. S. Bur. Comm. Fish. Biol. Lab., Boothbay Harbor, Maine). 1964. DETERMINING THE AGE OF YOUNG HERRING FROM THEIR OTOLITHS. Transactions of the American Fisheries Society, Vol. 93, No. 1, pp. 11-20.

The validity of the otolith technique for aging young Atlantic herring (*Clupea harengus harengus*) of the Maine commercial fishery was established by the Petersen and known-age methods. Tests of interpretation among different observers demonstrated a reproducibility of better than 90 percent.

The study is based upon a collection of approximately 20,000 length measurements and 7,500 otoliths assembled from the catches between 1960 and 1962, and shows that the fishery is essentially a one-year-class fishery for 2-year-old herring. (Auth.)

6639. Hansen, Martin J., and Thomas M. Stauffer (Inst. for Fish. Res., Michigan Dept. of Cons., Marquette). 1964. CADMIUM SULFIDE AND MERCURIC SULFIDE FOR MARKING SEA LAMPREY LARVAE. Transactions of the American Fisheries Society, Vol. 93, No. 1, pp. 21-26.

The usefulness of insoluble dyes injected under the skin as marks for larval sea lampreys was investigated. For marked lampreys recovered as larvae, the dye marks persisted for at least 4 years, they could be identified readily by external examination, and they caused little mortality. For lampreys marked as larvae and recovered as newly transformed adults, internal examination was desirable for identification of marks, and there may have been some loss of marks and mortality. A three-man crew marked 100 larval lampreys per hour. (Authors)

6640. Jensen, Loren D., and Arden R. Gauvin (Dept. of Zool. and Ent., Univ. of Utah, Salt Lake City). 1964. EFFECTS OF TEN ORGANIC INSECTICIDES ON TWO SPECIES OF STONEFLY NAIADS. Transactions of the American Fisheries Society, Vol. 93, No. 1, pp. 27-34.

Two species of stonefly naiads were exposed to the chlorinated hydrocarbons DDT, aldrin, dieldrin, and endrin and to the organic phosphates parathion, malathion, guthion, Dylox, Di-Syston, and Bayer-29493. After the introduction of the pesticide, tests were run for 96 hours with observations made after each 24-hour period. There was a definite increase in mortality for both Pteronarcys californica and Acroneuria pacifica with increasing exposure time. Higher concentrations of insecticides produced higher death rates more rapidly than lower concentrations. There were definite symptoms of poisoning noted during the 4-day bioassays. The symptoms did not vary for the two species of stonefly naiads. Animals displaying tremors or convulsions usually died within 24 hours. Both species could recover from the effects of the poisons if they were removed from the solutions of toxicant before the tremors began. Removal from the test solution after the onset of tremors did not prevent death. With the same insecticide, the resistance of P. californica was greater than that of A. pacifica. Larger specimens of P. californica were more resistant than smaller specimens. (Authors)

6641. Smith, Lloyd L., Jr., and Robert H. Kramer (Dept. of Ent., Fish., and Wildl., Univ. of Minnesota, St. Paul). 1964. THE SPOTTAIL SHINER IN LOWER RED LAKE, MINNESOTA. Transactions of the American Fisheries Society, Vol. 93, No. 1, pp. 35-45.

On the basis of 14,654 spottail shiners (Notropis hudsonius) from Red Lakes, Minnesota, growth rates, strength of year classes, and food utilization were studied. Males and females had different body-scale relationships, and females grew faster than males. There was high correlation between water temperature and growth rate. Strength of year classes was closely related to size of spawning population. Food habits were related to food availability in both plankton and bottom fauna. Shiner eggs were significant items of food in larger shiners. Bottom organisms were selectively taken, and larger cladocerans were selected by large fish. Cladocerans were preferred to copepods. (Authors)

6642. Mraz, Donald (Wisconsin Cons. Dept., Madison). 1964. AGE AND GROWTH OF THE ROUND WHITEFISH IN LAKE MICHIGAN. Transactions of the American Fisheries Society, Vol. 93, No. 1, pp. 46-52.

The round whitefish, though rarely abundant, is widely distributed in northern waters. It is one of the least studied of the coregonines; the present report is but the second for Great Lakes waters. Commercial production in Lake Michigan has been tightly confined to the northern portion. The period 1924-30 showed the best production: 200,000 to 359,000 pounds. Since 1956, production has been around 10,000 pounds or less. The present age and growth study is based on 208 fish collected by gill net in December 1951. The relation between total length in inches (L) and the weight in ounces (W) is described by the equation $\log W = -2.7232 + 3.2940 \log L$. Age-group III made up 66.3 percent, and age-group IV, 20.6 percent of the sample; age-groups V, VI, and VII combined contributed only 5.9 percent. The average length for all fish in the sample was 14.5 inches. Growth was calculated from a previously published linear body-scale relation with an intercept of 1.1 inches on the axis of fish length. The increments of calculated length declined steadily from a maximum of 4.6 inches the first year to 1.0 inch the eighth. A 3-year-old Lake Michigan fish (12.3 inches) is as long as a 5-year-old Lake Superior fish, and an 8-year-old Lake Michigan fish (18.9 inches) is 0.9 inch longer than the oldest (12 years) from Lake Superior. The smallest mature males and females were in the length intervals 12.0-12.4 inches and 13.0-13.4 inches, respectively. All males over 14.4 inches and all females over 14.9 inches were mature. The youngest mature males were in age-group II; 36 percent of II-group males but none of the females were mature. All fish older than age-group III were mature. (Auth.)

6643. Hayes, F. R., and E. H. Anthony (Inst. of Oceanog., Dalhousie Univ., Halifax, N. S., Canada). PRODUCTIVE CAPACITY OF NORTH AMERICAN LAKES AS RELATED TO THE QUANTITY AND THE TROPHIC LEVEL OF FISH, THE LAKE DIMENSIONS, AND THE WATER CHEMISTRY. Transactions of the American Fisheries Society, Vol. 93, No. 1, pp. 53-57.

The Productivity Index, which is derived (using appropriate factors) from the angling catch, commercial catch, or standing crop of fish, is given by the regression $\log PI = -0.236 + 1.47 \cdot 10^{-4} x_1 - 0.517 x_2 + 0.287 x_3$ where $x_1 = \sqrt{10^5 / \text{area in square kilometers}}$, $x_2 = \log \text{depth in meters}$, and $x_3 = \log \text{methyl orange alkalinity in p.p.m.}$ The equation accounts for 67 percent of the variability in Productivity Index, of which 20 percent is due to the area function, 29 percent to depth, and 18 percent to alkalinity. (Authors)

6644. Flick, William A., and Dwight A. Webster (Dept. of Cons., Cornell Univ., Ithaca, New York). 1964. COMPARATIVE FIRST YEAR SURVIVAL

AND PRODUCTION IN WILD AND DOMESTIC STRAINS OF BROOK TROUT, SALVELINUS FONTINALIS. Transactions of the American Fisheries Society, Vol. 93, No. 1, pp. 58-70.

Brook trout (Salvelinus fontinalis) from three wild populations were compared with domesticated hatchery strains with respect to growth, survival, and production in semi-natural environments (drainable ponds). Eggs from all strains were hatched and reared in the hatchery and planted as spring or fall fingerlings. Over-summer survival consistently favored wild strains (65 to 76 percent compared with 43 to 53 percent survival for domestic strains). Over-winter survivals were not different, although the effect may have been masked by other overriding factors in the test waters. Domestic strains maintained the initial size advantages held at planting. Larger size at planting was due to faster growth rate during hatchery existence. Net production, based on recovery weight less stocking weight, was similar for wild and domestic groups during the over-summer period (higher survivals in wild strains balanced by size advantage of domestic), but domestic groups generally showed lower production or net losses in the over-winter period. (Authors)

6645. Bjornn, Ted C., and Jerry Mallet (Idaho Dept. of Fish and Game, Boise, Idaho). 1964. MOVEMENTS OF PLANTED AND WILD TROUT IN AN IDAHO RIVER SYSTEM. Transactions of the American Fisheries Society, Vol. 93, No. 1, pp. 70-76.

During 1959-61, 10,000 catchable-sized, hatchery-reared, rainbow trout were jaw-tagged and released in the upper Salmon River, Idaho, and 2,247, 619, and 539 wild cutthroat trout, Dolly Varden, and rainbow trout, respectively, were caught on hook and line, tagged, and released in the Middle Fork of the Salmon River. More than 1,500 of the tagged, hatchery-reared, rainbow trout were recovered after being in the stream up to 1 year. Of those recovered the same season as released, more than 90 percent were taken within 2 miles of the release site. Ninety percent of those recovered after having been in the river over winter were taken within 5 miles of the release site. Of 253 tagged wild cutthroat trout recovered, 64 were recovered in release areas, and 189 were recaptured one or more miles from their release sites (average for the latter, about 19 miles). Of 95 tagged wild Dolly Varden recovered, 27 were recovered in the release areas, and 68 were recovered one or more miles from release sites (average for the latter, 22.2 miles). Twenty-seven tagged wild rainbow or steelhead trout were recovered; 14 in release areas, and 13 downstream from the release sites. Only 25.3 percent of the cutthroat trout and 28.4 percent of the Dolly Varden were recovered within 1 mile of release sites. (Authors)

6646. Fenderson, Owen C. (Maine Dept. of Inland Fish. and Game, Orono, Maine). 1964. EVI-DENCE OF SUBPOPULATIONS OF LAKE WHITE-

FISH, COREGONUS CLUPEAFORMIS, INVOLVING A DWARFED FORM. Transactions of the American Fisheries Society, Vol. 93, No. 1, pp. 77-94.

An unusually small, mature whitefish which appeared to be identical to the lake whitefish, Coregonus clupeaformis, was found in 22 lakes in north-western Maine in 1957-62. In most lakes the "dwarfed" form was found sympatric with "normal" lake whitefish, but populations that are completely dwarfed were found in three lakes. Distinct differences have been found in the size and age at which the two forms of whitefish become sexually mature, in their rate of growth, in their morphology, and in their erythrocyte antigens. Information on spawning habits provides further evidence of two separate breeding populations. All evidence leads to the conclusion that the two forms of lake whitefish are discrete, and that at least a partial barrier to gene flow exists between them. The differences between the two forms are highly variable from lake to lake, making any conclusions as to their systematic relationship tenuous. It is suggested that this variation may be due in part to varying degrees of convergence of two whitefish forms that once diverged from a common progenitor. (Auth.)

6647. Newell, B., and G. Dal Pont. 1964. AMMONIA IN SEA WATER. Nature 201: 36-37; CSIRO Abstracts, Vol. 12, No. 2, Abst. No. 123. 1964.

A very sensitive method for the determination of ammonia in sea water is described. It depends on the preliminary oxidation of ammonia to monochloramine by hypochlorite at pH 8. Afterwards the monochloramine is coupled with phenol at pH 3.4 and the resulting quinone chlorimide extracted into *n*-hexanol. In the presence of a slight excess of alkali, the quinone chlorimide reacts further with phenol to form blue phenol indophenol. (Authors)

6648. Saur, J. F. T., et al. (Comm. on Apparatus and Supplies, American Soc. Limnol. & Oceanog., Inc., U. S. Fish & Wildl. Serv., P. O. Box 640, Ann Arbor, Michigan). 1964. SOURCES OF LIMNOLOGICAL AND OCEANOGRAPHIC APPARATUS AND SUPPLIES. Limnology and Oceanography, Supplement to Volume 9 (Special Publication No. 1, Third Revision), 32 pp.

This revised edition of Special Publication No. 1 has three parts. In the first part, Apparatus and Supplies, under the alphabetically arranged headings and subheadings appear the names of the firms which manufacture or distribute the particular item of apparatus or supply. The second part, List of Firms, gives the names and address of the firms in alphabetical order. The third part, Supplemental Source Material, contains information on other sources, lists and publications which may be helpful in identifying equipment and locating sources of supply. (From preface)

6649. Wright, Richard T. (Inst. of Limnology, Uppsala Univ., Uppsala, Sweden). 1964. DYNAMICS OF A PHYTOPLANKTON COMMUNITY IN AN ICE-COVERED LAKE. Limnology and Oceanography,

Vol. 9, No. 2, pp. 163-178.

Changes in the species populations and plant pigment content of a community of phytoplankton in an ice-covered lake in eastern Massachusetts were followed closely for three months. During a snow-free period in January and February, a number of species of flagellated algae showed exponential increase to a maximum standing crop estimated at 31 mg C/100 cm². The various species occupied characteristic levels in the water column, indicating a species-specific preference of light quantity, quality, or both. The layers of the water column receiving 0.5-20% of incident radiation accounted for over 95% of the phytoplankton. A snowfall caused a mass movement of most species of the uppermost 50 cm, a region previously avoided because of excess light. C¹⁴ measurements indicated adaptation of low light intensities and demonstrated graphically the effect of a snow cover. The community declined rapidly following a series of snowfalls which left 29 cm of snow on the ice and allowed only 0.2% of incident light to penetrate to the water column. Laboratory experiments revealed that two species of cryptomonads isolated from the lake are capable of growing at low temperatures in the dark on acetate but not on glucose and were also able to supplement heterotrophic growth with autotrophic growth in light of as low as 65 lux intensity. (Auth.)

6650. Menzel, David W., and John H. Ryther (Woods Hole Oceanographic Inst., Woods Hole, Massachusetts). 1964. THE COMPOSITION OF PARTICULATE ORGANIC MATTER IN THE WESTERN NORTH ATLANTIC. *Limnology and Oceanography*, Vol. 9, No. 2, pp. 179-186.

The composition of particulate matter in the western North Atlantic is examined to determine relationships between carbon, nitrogen, phosphorus,

and chlorophyll. The regressions of phosphorus or chlorophyll on nitrogen or carbon, when extrapolated toward the origin, indicate appreciable but variable amounts of nitrogen and carbon in the absence of phosphorus and chlorophyll. The regression of phosphorus on chlorophyll, on the other hand, has its intercept at the origin. These observations indicate that chlorophyll and phosphorus are decomposed or mineralized at essentially the same rate, while carbon and nitrogen are more refractory. The relationship between these parameters and the distribution of detritus is discussed. (Authors)

6651. Mauchline, John, Angela M. Taylor, and Eric B. Ritson (Biol. Group., United Kingdom Atomic Energy Authority, Windscale, Cumberland, England). 1964. THE RADIOECOLOGY OF A BEACH. *Limnology and Oceanography*, Vol. 9, No. 2, pp. 187-194.

The accumulation of fission products, especially the insoluble radionuclides Ru¹⁰⁶, Ce¹⁴⁴, Zr⁹⁵, and Nb⁹⁵, by the fauna and flora on Windscale Beach is affected by the following factors: (1) the particle size and chemical composition of the substratum; (2) wind action on contaminated silt lifting it from near low-water mark and depositing it near high-water mark; (3) the vertical position of organisms on the beach, and, therefore, their coverage time by contaminated sea water; (4) movement of organisms on the beach which alters their coverage time; and (5) fresh-water seepage and rainfall, assuming that their radionuclide contents are less than that of the sea water, causing decontamination of the organisms by washing.

The position of an organism in the food chain is not considered to be a primary factor determining the levels of radionuclides accumulated by it. (Authors)

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